SCIENCE

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FRIDAY, JUNE 7, 1901.

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FRANÇOIS MARIE RAOULT.

THE death of Raoult, on April 1, 1901, removes from France one of her most brilliant investigators. Raoult was born at Fournes (Nord) on May 10, 1830, and was, therefore, nearly seventy-one years old when he died. After finishing his academic training in Paris, he began his career as a teacher in the Lycée at Reims at the age of twenty-three. In 1870 he was called to the chair of chemistry at Grenoble. In 1889 he was elected dean of the Faculty of Sciences in Grenoble—a position which he held until his death.

The earlier work of Raoult was devoted to problems of a purely physical nature. His thesis, presented for the degree of Doctor of Science was on 'The Electromotive Force of Voltaic Cells,' and much of his earlier work had to do with the phenomena connected with electrolysis.

His most important work, however, and that with which his name will always be connected, was done after 1870, while at Grenoble. When Raoult took up the study of the lowering of the freezing-point and of the vapor-tension of solvents by dissolved substances, our knowledge of these phenomena was hardly more than qualitative. A few regularities had been pointed out by Blagden, Coppet, Wüllner, Emden, Rüdorff and others, but scarcely any generalization worthy of the name had been reached.

The reason why the laws which obtain in these fields had not been discovered is to be found chiefly in the fact that aqueous solutions had been used, and we know to-day that water dissociates electrolytes, and in varying amounts depending upon the dilution of the solution. Thus, of all the solvents which could have been used in studying these phenomena, no one was so poorly adapted to the discovery of any relations which might exist as water.

When Raoult took up the study of the lowering of the freezing-point of water by dissolved substances, he did not limit himself to aqueous solutions, but employed solutions in acetic acid, benzene, nitro-benzene, etc. From his work with non-aqueous solutions he discovered his well-known law: "A molecule of any substance dissolved in one hundred molecules of a liquid lowers the freezing-point of the latter a nearly constant amount." The experimental data upon which this law is based were published in 1884.*

A little later (1886) Raoult took up the study of the lowering of the vapor-tension of solvents by dissolved substances. Here also he worked with non-aqueous solutions, and showed that the lowering of the vapor-tension is proportional to the ratio between the number of molecules of the dissolved substance and the total number of molecules present.

The work of Raoult, then, brought out this important point, that the lowering of the freezing-point of a solvent, as well as the lowering of its vapor-tension, depends only upon the ratio between the number of parts of the dissolved substance and the number of parts of the solvent which are present.

This work of Raoult, however, led to a still more important discovery. He found that electrolytes, *i. e.*, those substances which in solution conduct the current, give greater lowering of the freezing-point of water than non-electrolytes. An example will make this clear. Hydrochloric acid, sodium hydroxide and sodium chloride in water lower its freezing-point nearly twice as much as methyl alcohol of the same concentration. We recognize in the acid, base and salt types of electrolytes, and in methyl alcohol a typical non-electrolyte. Raoult was not able to point out the meaning of this important discovery. This was left for another.

The work of Pfeffer on the osmotic pressure of solutions led, in the hands of van't Hoff, to the discovery of the relations between the osmotic pressure of solutions and the gas-pressure of gases. But these relations hold only for the osmotic pressures of non-electrolytes. The electrolytes all exert an osmotic pressure which is greater than that shown by the non-electrolytes. van't Hoff was not able to explain the abnormally large osmotic pressures exerted by the electrolytes.

The Swedish physicist, Arrhenius, took up this question, and, as we know, furnished a satisfactory answer to it. He asked, Why is it that electrolytes give abnormally large osmotic pressures, abnormally large depressions of the freezing-point and vapor-tension of solvents? The work of Raoult had shown that lowering of freezing-point and of vapor-tension depends only upon the number of parts present in a given volume of the solution. Therefore, when these phenomena manifest themselves to an abnormally large degree it means that we have more parts present in the solution than we suppose. This gave to Arrhenius the key to the solution of the problem, and the theory of electrolytic dissociation was the result.

This work of Raoult, together with that of Pfeffer on osmotic pressure, forms the foundation of the new physical chemistry.

An account of the work of Raoult should

* *Ann. Chim. phys.* [6] **2**, 66. Harper's Science Series, IV.

be supplemented by a brief reference, at least, to his more important characteristics. He was not a man who desired fame, but devoted his whole life to one ideal—the discovery of truth. Although connected with a comparatively small institution, he never lost his enthusiasm for his work, and one of his very last investigations, on the lowering of the freezing-point of water produced by non-electrolytes, probably contains the most accurate measurements of these values which have ever been made.

Raoult as a man seems to have combined most of those qualities which are so much admired. We have abundant evidence of his kind-heartedness and genial disposition. A letter from his pen was always an inspiration to more strenuous effort in research, and invariably left the impression that the highest aim of man should ever be to increase the sum of human knowledge.

In Raoult not only France has lost her most prominent physical chemist, but the world has lost one of the leading men of science.

HARRY C. JONES.

CHARLES HERMITE.

THE fourteenth of January, 1901, should be marked with a black stone in the annals of mathematics. Then the eminent geometer, the incomparable man, the great Hermite, one of the glories most pure of France, was lost to science, and implacable death threw into mourning his family, his friends and his admirers.

As mathematician of the first rank he leaves to the glory of his country and of all humanity a superb scientific monument erected in sixty years, completely dedicated to 'his dear *analyse*' (to use one of his phrases) and to preparing, by the infusion of his genius placed at the service of teaching, that galaxy of illustrious mathematicians who now so much adorn our sister nation. Like Sturm, he united in an extraordinary degree the qualities of a professor who wins the love of his disciples to those of one who inculcates the love of science for science.

Endowed, like his compatriots Pascal and Clairaut, with singular precocity, we see him, yet a scholar of the lyceum Louis le Grand, win the prize for mathematics with a noteworthy thesis, and shortly after, as student of the Polytechnic School, attract the attention of Jacobi with his first works and place himself as of right in the first rank among the analysts of Europe.

It is not our object to make a minute analysis of the works of the great geometer, to which would be necessary time and competence that we lack. Our aim is much more modest; we seek to render what is heartfelt homage to the man we have so deeply venerated and from whom we have received infinite proofs of benevolence during the fifteen or sixteen years that we have had the honor to possess his friendship, in so many ways precious.

It is not possible, speaking of Charles Hermite, to fail to say how in the higher analysis, in algebra and in the theory of numbers, one encounters everywhere the footprints of his giant tread. How could we leave unmentioned his memoir on the exponential function, where in demonstrating the transcendence of the number e he opens the way which eleven years after conducted Lindemann to the demonstration of the analogous property of π, solving in negative form the celebrated problem which for two thousand years had in vain fatigued geometers?

Nor can we pass in silence the enormous contribution which Hermite brought to the *Theory of Forms:* his law of reciprocity, his admirable researches on associate covariants, his work on quintic forms, his memoir on the equation of the fifth degree and his celebrated theorem having Sturm's as corollary.

The works of Charles Hermite in the theory of functions are a new revelation of his genius. His profound investigations on Abelian functions, their division and their transformation, as also those relative to elliptic functions, form a monument of glory erected to French science, disclosing the sagacity of the grand analyst in the facility with which are deduced from the most lofty analytic investigations, corollaries which unveil difficult properties of the theory of numbers.

Neither can we neglect to mention the work, 'Sur quelques applications des fonctions elliptiques' (1885), of which only the first part was published: in this are found the beautiful applications of these functions which conduct him to the general integral of the equation of Lamé on the equilibrium of temperature of a homogeneous ellipsoid, which leads the author, in two particular cases, to the study of the rotation of a solid body around a fixed point (when there do not exist accelerating forces) treated by Jacobi, and to the consideration of the conic pendulum.

So far as we know, Hermite leaves two didactic works: his 'Cours de la faculté des sciences de Paris' (1891), and his 'Note sur la théorie des fonctions elliptiques' (168 pages), which serves as appendix to the 'Cours de calcul differentiel et integral,' of J. A. Serret (4th ed., 1894).

We have from him also two brief but interesting notes on the invariants of binary forms of the 5th and 6th order in the French translation of Salmon's 'Higher Algebra.'

The French geometer had the good fortune not granted all great men to see recognized in his lifetime by the scientific world his extraordinary merit. The 24th of December, 1892, his sixtieth birthday, the friends, the disciples, the admirers of the great geometer assembled at the Sorbonne to present him the gold medal struck in his honor by international subscription. The illustrious artist Chaplain cut upon it the bust of the one commemorated, and translated on to metal with admirable fidelity his venerable face, affable and frank, illuminated by the scintilla of genius.

The Minister of Public Instruction, M. Ch. Dupuy, presented to Hermite in the name of the President of the Republic the insignia of Grand Officer of the Legion of Honor, and the messages were read of those who from various parts of the world associated themselves with the splendid ceremony.

High testimony of admiration and sympathy was offered the great geometer more recently upon the occasion of the meeting at Paris, last August, of the International Congress of Mathematicians.

The Congress sent him a telegram of admiration and sympathy (he was at Saint-Jean-de Luz). This act caused vast satisfaction and profound emotion to the scientist, as he wrote me in one of his last letters.

Hermite retained to the last day of his life his privileged intelligence; but his body suffered. In a long letter of his, a few days before his death, he complained of his attacks of asthma and of the lack of appetite and of sleep: he seemed to foresee the nearness of his end, so that sending me one of his works, he said that this would be without doubt *the last!* and that he had in great part accomplished it at Saint-Jean-de Luz, where by benefit of the mild climate had reawakened his mathematical activity. This last work is a letter to Professor Pincherle published in Tomo V. of the *Annali di Matematica.*

He told us also that he had sent a brief article to the new journal, *Le Matematiche,* of Professor Alasia.

We will end by expressing a wish. We wish that those who have the authority would take the initiative toward an international subscription for a work containing an extended biography of the ever-memo-

rable geometer, and a minute analysis of his works; perhaps might be added some brief articles by very illustrious living mathematicians; something, in fine, which would be as a funeral crown offered to the memory of the great dead.

[Written by Juan J. Durán-Loriga for *Le Matematiche*, and translated by the English editor G. B. Halsted.]

THE EXTRA-NUPTIAL NECTARIES IN THE COMMON BRAKE, PTERIDIUM AQUILINUM.

THE common brake, *Pteridium aquilinum* Kuhn (*Pteris aquilina* L.) has for a number of years been used in educational institutions in this country as a laboratory type, more especially in connection with introductory courses in general biology in which both animal and plant types are used. That the presence of nectar-secreting organs in this form, therefore, should have been so generally overlooked as the writer has been led to believe, the more especially as they were made known to the botanical world as early as 1877,* is a matter of some surprise.

It is our purpose by means of the present paper to review the facts already published, and to present them, together with the writer's own observations, in order to draw to the attention of teachers of biology the fact of the presence, in a non-flowering plant, of an organ such as is thought of usually in connection with the phanerogams alone. Interest attaches to this structure, also, from the fact that a definite organ of secretion may be observed by students in a much-used laboratory type, thereby enhancing its value as such.

The extra-nuptial nectaries in *Pteridium aquilinum* were discovered by Francis Darwin (*l. c.*), and their microscopic appearance was briefly described by him in 1877. The possible biological meaning of these organs was also discussed.

Two years later, Bonnier* pointed out the presence of similar structures in certain genera of ferns, namely, in *Cyathea*, in *Hemitelia* and in *Angiopteris*, and briefly described some points in their anatomy. In addition, this author examined the nectar of the plant here under discussion.

In 1891, in view of the scanty description till then extant, W. Figdor† published a fuller account of the nectaries in *Pteridium*. This description includes the external appearance and the histology of the gland, and is accompanied by two illustrations. Later in the same year Figdor's paper was reprinted, accompanied by some notes and one illustration‡ additional, by H. Potonié. §

EXTERNAL APPEARANCE.

The nectaries in *Pteridium aquilinum* occur on the fronds at the bases of the pinnæ and pinnulæ on the morphological lower side of the leaf. The largest and most conspicuous are the lowermost, that is, those at the bases of the first pair of pinnæ. On one developing frond, therefore, one may observe a complete developmental series. When examined macroscopically the glands appear as approximately oval areas just below and extending somewhat into the angles formed by the mid-veins of the first and second, and second and third, orders. The external surfaces of the glands are smooth, because of the absence of the chaffy scales found elsewhere on the young frond.

* Darwin, Francis. *Jour. Linn. Soc.* **15**: 407. 1877.

* Bonnier, G. 'Les nectaires.' Ann. Sci. Nat. Bot. VI. **8**: 5-212. 1878.

† Figdor, W. 'Ueber die extranuptialen Nectarien von *Pteridium aquilinum*.' Oesterr. botan. Zeitschr. No. 9. 1891.

‡ Reproduced in Engler and Prantl's 'Natürlichen Pflanzenfamilien,' **1**⁴: 67.

§ Potonié, H. 'Die 'extranuptialen' Nectarien beim Adlerfarn.' Natur-Wiss. Wochenschr. **6**: 401. 4 O. 1891.

Their color, according to Figdor, is brown-red in the central part of the nectarial surface, developing into red on the edges. Darwin's statement is that they are 'smooth green.' In our east North American plants, the color in the young state is much as described by Figdor. Later the red color is lost, and the organs are then deep green. Darwin's and Figdor's statements may, therefore, be harmonized as they appear to apply to different stages of growth, if indeed the European plants do not differ among themselves and from the American. Figdor further notes that the membranes of the nectaries early become brown and that, later, they thicken considerably. The use of the red color is quite problematical.

The secretion of nectar is very abundant during the unfolding of the frond. So abundant is it, in fact, that large beads of the limpid fluid may be seen from a distance, resting on the nectaries or running down the petiole. With a hand lens, one may easily note the accumulation of nectar after the surface has been wiped off. Darwin found that a drop of the liquid was formed in six minutes. Handling and tasting the secretion shows it to be sirupy and very sweet. According to Bonnier (*l. c.*) the sugars saccharose and glucose are present. Here, as in analogous organs in other plants, the exudation is quite independent of bleeding pressure. Leaves which have been broken off continue to produce nectar for some days, provided, of course, that they be kept in fair condition. As the frond ages, the activity of the glands is lowered, until they finally cease to secrete and become functionless as nectaries.

ANATOMY.

The epidermis consists of polygonal cells, with a depth that is greater by about one-third than that of the rest of the epidermal cells of the petiole; in transverse section they are nearly square (Fig. 5). These cells have red coloring matter in their sap, although the color is not confined merely to the glandular areas, but is usually extended from them in bands of various breadths up and down the petiole. The loss of this color as the age of the leaf increases has been noted above.

Scattered here and there on the surface are a number—a dozen or more—of stomata. These are irregular in position, in surface view very much rounded (Fig. 1a), resembling in this respect very closely the water pores of the garden nasturtium (*Tropaeolum* sp.).

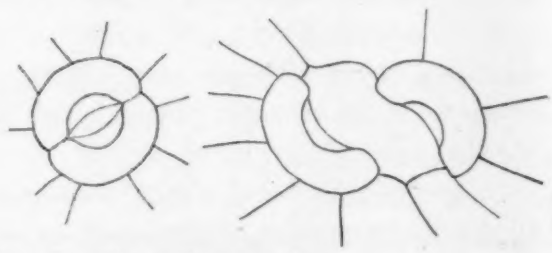

Fig. 1a. Stoma from nectary.

Fig. 1b. Stoma in which the guard cells have been spread apart by growth of the surrounding tissues.

They do not, however, lack so entirely the characters found in air stomata, as is shown in the figure. The delicate hinge mechanism is not present, and the thickening of the walls is even all around, in which the stomata agree in essential detail with water stomata, such as are found in *Secale cereale, Conocephalus ovatus* and other plants.

In some cases the stretching of the epidermis incident to growth causes a displacement of the guard-cells (Fig. 1b), and a consequent enlargement of the pore. The guard-cells are raised above the general surface (Fig. 2), in which particular the writer's observations fail to coincide with those of Figdor, whose illustration in other regards also does not show the guard-cells to possess any characters usually found in such. Figdor states that a 'test with a sugar solution indicated that some of the

stomata carry on the usual function while others serve for the exudation of nectar.'

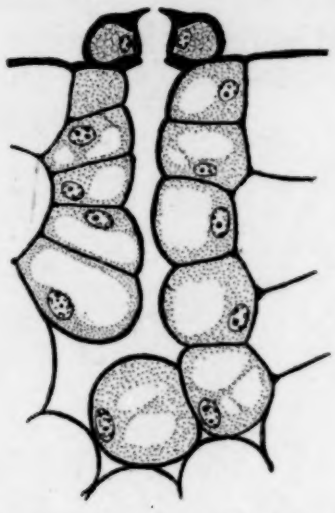

FIG. 2. Transverse section through a stoma and adjacent tissue of the nectary.

It is, however, not clear how the test was applied, and we believe that in view of the facts the question of the function of the stomata may be decided upon other grounds. A very few of these which occur on the edge of the nectarial surface have the appearance of air stomata, but by all odds the big majority have the characters above described, from which it appears that the guard-cells are in such cases quite functionless in opening or closing the entrance. Furthermore, the nectar when it is being secreted is so abundant that it must needs hinder completely the gas interchange at that time. That such interchange takes place later is almost certainly the case, as is indicated by the condition of the chlorophyll-bearing cells of the gland. Nor does the immobility of the guard-cells call for remark, inasmuch as the amount of tissue involved in transpiration coincident with respiration is relatively so very small as to have no effect upon the turgor of the whole leaf. Stomata are absent from the rest of the petiolar surface, excepting that, as Potonié * has pointed out, they are present along two bands on either side of the morphological upper flattened side of the leaf-stalk, beneath which the hypodermal stereome is absent, though elsewhere present except in the nectaries. The relation of these bands to the glands should here be pointed out. As just stated, the rachis possesses two such bands, which pass *without dividing*, each along the lower margin of one of the first pair of pinnae. The band lying along the upper margin of a pinna and that along the side of the rachis nearer the same and above its insertion arise *at the same point*. At this point lies the nectary. These relations, which are exhibited in Fig. 3, *a* and *b*, are repeated at each fork in the frond.

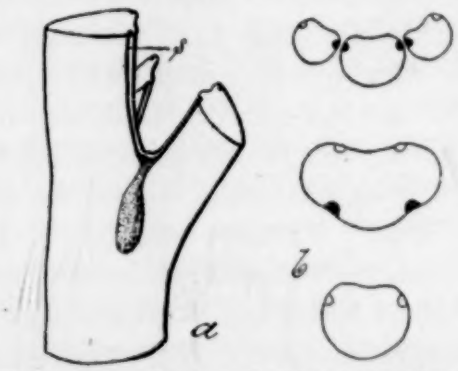

FIG. 3. *a*, lateral view of rachis showing the nectary and the stomatal bands, *s*; *b*, diagrams showing the distribution of the bands.

Through these true pneumathodes, by reason of the anatomical relations just indicated, the gas interchange may easily take place between the glandular tissue and the air. On old dead fronds the nectarial stomata are so large as to be seen with the naked eye, from which fact the presence and extent of the gland beneath may be determined.

Beneath the epidermis lies the glandular tissue extending to a depth of 1 mm. or a fraction more. In a transverse section through fresh material, the extent of the same may be recognized by the deeper green color contrasting with the lighter color of the surrounding tissues. The cells are rounded in form, as described for

* Potonié H. Jahrb. des Königl. bot. Gartens zu Berlin, **1**: 310-317. 1881.

Hemitelia by Bonnier (*l. c.*), and contain relatively much more protoplasm than the contiguous cells, large nuclei and chloroplasts. The cytoplasm is vacuolated and the cell walls are thin. The cells stand in contrast with the ground parenchyma on account of their smaller size, their diameters being between the ratio of 1 to 3 and 1 to 4. The cells near the epidermis are larger than those lying deeper in the gland. In making the foregoing statement, we differ from Figdor, who says "The single elements of the gland are about the size of the cells of the fundamental parenchyma." Frequent small intercellular spaces occur. These connect with each other and finally with the substomatic spaces which are of considerable size (Fig. 2). Through these, therefore, the secretion may find its way to the surface of the gland. Bonnier, in the paper above cited, makes no mention of the substomatic spaces in the special treatment of the ferns. Further on, however (p. 151), he makes a general statement to the effect that he had established the fact that, in the cases of nectaries with stomata, these are either without a substomatic space or have only very small ones. His figure representing the nectary of *Hemitelia obtusa* (on his Pl. 1, Fig. 9) certainly bears out his general statement. We cannot, however, regard this figure as satisfactory. No attempt was made to delineate the stomata, except in very schematic fashion, on account of the small size of the drawing, for which reason also the possibility of representing substomatic and intercellular spaces was very much lessened. The presence of a large substomatic space, however, may not be regarded as of any importance in the economy of such an organ as a nectary, in which the movement of the fluid is the important and characteristic feature.

Passing on to consider the relation of the nectary to the vascular tissue, we notice in the first place the distribution of bundles in the immediate vicinity of the former. Fig. 4 shows, in diagrammatic form, this relation, from which there appears to be little variation to be noted beyond. A broad

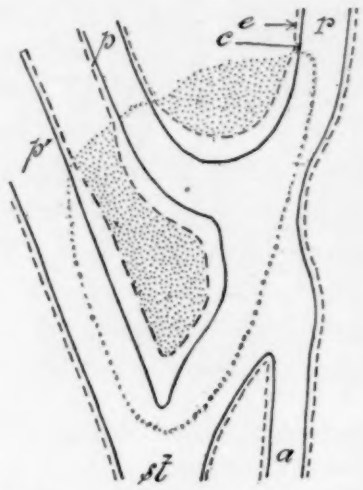

FIG. 4. Diagram showing the relations of the vascular tissue and gland. The dotted outline shows the extent of the latter. *c*, limit of the cribral part of the bundle; *e*, endodermis. The pericycle is included between these.

stele* (*st*) divides at the lower angle of the nectary, one branch (*p'*) running along one side of the gland and thence into the pinna, the other and larger passing along the other border of the gland, broadening as it goes into a vascular plate which consists of a dense complex of short, irregular wood elements, well-developed cribral cells and a several-layered pericycle, to be described below.

From this plate of vascular tissue, which lies beneath and somewhat obliquely across the nectary, pass forward two branches, *p* and *r*, which go into the pinna and rachis, respectively. Sometimes four branches arise by the splitting of these two, but the general character of the arrangement is quite constant. Sometimes a small stele runs into the complex, as shown at *a*, Fig. 4.

* The term stele is used here, in the ferns, without reference to the question of morphological propriety. See Jeffrey, E. C., 'The morphology of the central cylinder in the angiosperms,' *Trans. Can. Inst.*, Vol. 6.

In no case examined, however, does a bundle end in a gland, as held by Figdor (*l. c.*). The relations of the glandular and vascular tissues are none the less intimate and striking, as we shall see in coming to the second point.

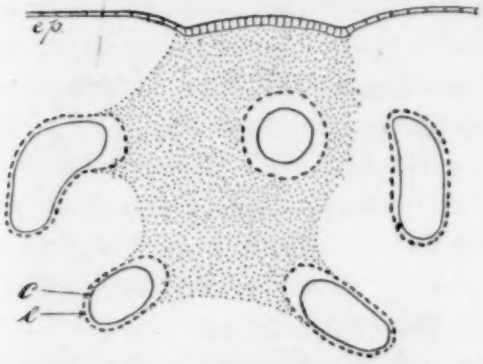

FIG. 5. Diagram of a transverse section through a nectary. *ep*, epidermis; *c* and *e*, as in Fig. 4.

In examining a transverse section we see the glandular tissue extends towards and comes partially to surround the vascular bundles adjacent (Fig. 5), and, further, that the pericycle of these bundles, in the regions contingent upon the gland, consists of three to four layers of enlarged cells, and not, as is to be found elsewhere, of a single layer of cells (Fig. 6, *a* and *b*). These enlarged pericycle cells are abundantly supplied with cytoplasm of fine, tenuous structure with large and often irregularly shaped nuclei. The cytoplasm is little vacuolated.

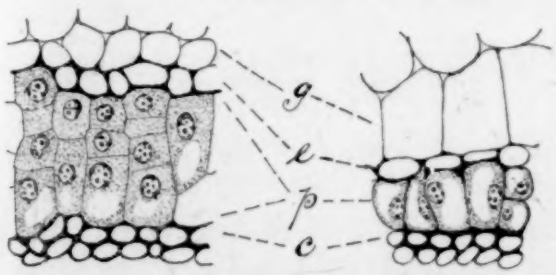

FIG. 6. *a*, transverse section through a portion of the pericycle in contact with the glandular tissue. *b*, a similar portion in a bundle adjoining the ground tissue. *c*, cribral cells; *p*, pericycle; *e*, endodermis; *g*, ground parenchyma.

The pericycle cells found elsewhere in the petiole, where the glands are active, are supplied with a scant amount of cytoplasm. The endodermis,* which is usually regular and well marked, is, in the vicinity of the nectary, quite irregular and often difficult to recognize, and its cells have very much the character of the adjoining gland cells in shape and content. We may thus regard these cells, namely, those of the endodermis and pericycle, where the bundles and nectary touch, as a part of the gland. Whether we may assign a different function or the same to these cells may not be answered. Bonnier (*l. c.*) has indicated that, besides the two sugars above named, an invertin is to be found in the gland. The suggestion occurs to us that this substance originates in the pericycle. Nevertheless, the greater development of the pericycle as already indicated can perhaps be entirely accounted for by the activity of its cells in passing the soluble carbohydrates from the moving sap into the gland.

After the activity of the gland ceases, the thickening of the walls of the endodermis commences, in all the bundles lying in the petiole near the fork formed by the pinna, and the process extends to the surrounding parenchyma. In this way the strength of the fork is very materially heightened. We notice also, with Figdor, a thickening of the walls of the gland cells, a process which takes place in all the chlorophyll-bearing cells beneath the stomatal bands.

In offering a teleological explanation of the organs above described, F. Müller pointed out that in Brazil the fern is visited by an ant (*Cremogaster* sp.) of which a leaf-cutting species, an *Oecodoma*, stands in dread. To this Francis Darwin † answers that the plant has few natural enemies—meaning, presumably, in England, though this is equally true, so far as observation goes, in North America. Francis Darwin further suggests, in the view of the possible weakness of the above explanation, that the

* Derived from the phloeoterma of Strasburger.

† *Nature*, **16**: 100.

gland is either an organ which was formerly of use and is now passing away, or that it is connected 'with some unknown process of nutrition.' That its activity 'is decidedly connected with the growth of young fronds' stands in favor of the latter view. A supplementary suggestion has already been made by the writer to the effect that the solution of actively secreted sugar may act as a carrier for some other substance in the nature of an excretion.*

The writer has observed on the surface of the gland in some cases a felt of dark-colored fungal hyphae. The occurrence of these, when the leaf-blade has not yet unfolded, carries with it the suggestion that the nectarial surface is a constant infection-point, the sugary fluid acting as a nutrient medium and the entrance of the hyphae being made easy by the large stomata.

ORIGIN OF THE NECTARY.

Certain facts which have been pointed out give us grounds for offering a view of the origin of the nectaries, to the effect that they have arisen as portions of the respiratory areas of the petiole and its branches, which have become secondarily specialized as nectar-secreting glands.

In support of this view, we recall the relation of the nectaries to the stomatal bands (pneumathodes), with which they have a practically identical structure, with, however, a more intimate connection with the vascular system. We regard the wide distribution of these band-shaped pneumathode regions in the ferns as indicating a phylogenetically greater age than that of the nectaries as such. If this be true, Francis Darwin's suggestion, quoted above, that the nectary is an organ once useful but now on the wane, must probably be thrown out of court, though not necessarily. Further, the stomata, while clearly functionless as pneumathodes during the period of the gland's activity, and deprived of the delicate mechanisms for closure both by their own development and the manner of growth of the surrounding epidermis, are nevertheless to be regarded as respiratory mechanisms, serving the function of setting free the nectar. The analogous conditions in *Tropaeolum* and other plants may be cited as a parallel case save in the nature of the exudate. The presence of the substomatic spaces, usually broader beneath the stoma than represented in Fig. 3, together with the intercellular spaces both suggest the same thing.

It is to be questioned if the presence of chlorophyll in the gland has any necessary relation to the activity of the organ as a gland, upon which point further study of the cytological phenomena may throw light.

Haberlandt* has drawn the provisional conclusion with regard to nectaries in general, that they have been derived phylogenetically from hydathodes. In summarizing the present paper we submit the case described herewith as one in which the nectaries have been derived both ontogenetically and phylogenetically from pneumathodes.

Francis E. Lloyd.

Teachers College,
Columbia University.

* Bonnier (*l. c.*) has shown that other substances are thrown off in small quantities.

* 'Physiologische Pflanzenanatomie,' p. 432.

THE BRITISH NATIONAL ANTARCTIC EXPEDITION.†

The resignation of the man who is, before all others, fitted to be the Scientific Leader of the National Antarctic Expedition will lead the fellows of the Society to expect some statement of the causes which have produced a result so disastrous to the interests of science. The following statement gives an account of the efforts which

† A letter addressed by Professor Edward B. Poulton, of Oxford University, to the fellows of the Royal Society.

have been made to prevent the injury which has occurred.

In the autumn of 1899, Captain Tizard, F.R.S., and I were appointed as the representatives of the Council of the Royal Society on an Antarctic Executive Committee of four, Sir Clements Markham (Chairman) and Sir R. Vesey Hamilton being the representatives of the Royal Geographical Society's Council. Our functions were defined under various heads in a printed form previously agreed upon. No. 2 instructed us to submit a program of the Expedition for approval to the Joint Antarctic Committee (consisting of sixteen representatives of each Council), "such a programme to include (*a*) A general plan of the operations of the Expedition, including instructions to the Commander, so far as this can be laid down beforehand. (*b*) The composition of the executive and scientific staff to be employed, the duties, preparation and accommodation for, and pay of, the several members." No. 4 instructed us "to make the appointments of the several members of the executive and scientific staff, subject to the final approval of the Joint Committee." The word 'civilian' was nowhere employed. The four members of the Executive Committee were placed on the Joint Committee and all Sub-Committees.

Before the first meeting of the Executive Committee, Captain Tizard and I were seen by Professor Rücker, who informed us that one of the first points which the Council of the Royal Society desired us to raise was the relation in power and status between the Commander and the Scientific Leader. In the German Expedition, which was to start about the same time, the Scientific Director had absolute power, and we were asked to consider the possibility of such an arrangement in the English Expedition.

At one of our first meetings, I think the very first, I raised this question and supported the German arrangement. The other three members, who were all naval experts, convinced me that English law required the Captain to be supreme in all questions relating to the safety of his ship and crew. Since that time I have never disputed this point, but always maintained that the scientific chief should be head of the scientific work of all kinds, including the geographical, and that the Captain should be instructed to carry out his wishes, so far as they were consistent with the safety of ship and crew.

We then considered the appointment of Scientific Leader and decided to nominate Professor J. W. Gregory, then of the British Museum of Natural History. In suggesting his name to my colleagues, I was influenced by his proved success in organization and in the management of men in a most difficult expedition (British East Africa in 1893), by the wide grasp of science which enabled him to bring back valuable observations and collections in so many departments. His ice experience in Spitzbergen and Alpine regions was also of the highest importance, together with the fact that his chief subject was geology, a science which pursued in the Antarctic Continent would almost certainly yield results of especial significance. In addition to all these qualifications, Professor Gregory's wide and varied knowledge of the earth rendered his opinion as to the lines of work which would be most likely to lead to marked success extremely valuable in such an expedition. No one was more competent to state the probable structure of the Antarctic Continent and its relation to that of the earth. This opinion of Professor Gregory's qualifications for the position of scientific leader of an Antarctic expedition is, I know, widely held among British scientific men. In their wide combination, and united as they are to tried capacity as a leader, they are unique, and

an expedition with Professor Gregory for its scientific chief, with as free a hand as English law would permit, was bound to yield great results.

The Committee deputed me to ask Professor Gregory if he would consent to be nominated. In doing so I carefully explained that he could not have the full powers of the German scientific leader. He consented to consider the offer favorably, but wished for a more definite statement of his position and powers, and for a program of the Expedition. Shortly after this he was appointed professor of geology at Melbourne, and left England. On the voyage he wrote a long letter to the Executive Committee (dated January 19, 1900), which he posted to me at Port Said. In it he said, "I have heard so many rumours as to what is wanted, that I cannot be sure whether I correctly understand the views and wishes of the Executive Committee: I therefore write mainly for the sake of correction, so that I may avoid any misstatements in communicating with the Council of Melbourne University, when the proposal from the Committee reaches me." The plan drafted by Professor Gregory in this letter included the provision of a landing party with house, observing huts, dog-stable, etc., and he argued that its organization should be placed 'in the hands of the scientific staff,' but that, under any circumstances, the Scientific Leader should have the opportunity of controlling a small independent party on land. This letter was read by all the members of the Executive Committee, and, on June 15th, at the close of the meeting, the Secretary despatched a cable to Professor Gregory containing the information "Your letter of January 19 has been received and approved." As soon as Professor Gregory received this he sent a decoded copy to Sir Clements Markham, who did not correct it. Indeed, at this period Sir Clements Markham frequently expressed opinions which implied that he contemplated the establishment of a landing party independent of the ship. Professor Gregory applied for and received from the Council of Melbourne University permission to take the appointment on the lines of his letter of January 19th.

Professor Gregory's name was very warmly received by the Joint Committee and he was appointed Scientific Head on February 14, 1900; the words "Formally appointed, wire when fully able to decide," being cabled to him a few days later by Sir Clements Markham.

Lieutenant Robert F. Scott, Torpedo Lieutenant of H. M. S. *Majestic*, was appointed Commander of the Expedition by the Joint Committee, on May 25, 1900.

In June, 1900, my attention was called to a statement in the *Press* describing Professor Gregory as 'Head of the Civilian Scientific Staff.' Feeling confident that the word 'civilian' was not employed in the resolution accepted by the Joint Committee I wrote to Sir Clements Markham on the subject. In his absence the Secretary replied, "The words 'Head of the Civilian Scientific Staff' are the exact words of the resolution passed by the Joint Committee appointing Professor Gregory, and I know Sir Clements himself was very anxious to have the word 'civilian' in, so that no difficulty might arise between Professor Gregory and the Commander of the Expedition, since the civilians would not be the only scientific men on board." The word 'civilian' does certainly occur in the minutes of the meeting. On the other hand, Sir Clements Markham was not present on that occasion (February 14, 1900); the word 'civilian' did not occur in the instructions issued to the Executive Committee, and was not used in my letter to Sir Clements (February 15th) describing the result of the meeting and asking him to cable.

The words I used, 'leader of Scientific Staff,' were not commented upon in his reply (February 16th), stating that the cable should be sent. The word 'civilian' was not used by Dr. W. E. Blanford, writing to convey the unanimous recommendation of the Geological Sub-Committee that Professor Gregory should be 'chief of the Scientific Staff of the Expedition.' Professor Herdman, who seconded the resolution on February 14th, and I, who proposed it, both remember the words 'Scientific Leader of the Expedition.' I have not been able to recover a copy of the notice convening the meeting, in which the agenda were put down. It would, however, have been unreasonable for the Joint Committee to have accepted the word 'civilian' when it had no information before it which justified the expectation that naval officers would be lent by the Admiralty.

At the meeting of the British Association at Bradford, I explained the situation to Professor Rücker, who agreed with me that it was full of danger, on account of the reasons alleged for the use of the word 'civilian,' viz., in order to discriminate between the science under Professor Gregory and that under the Commander. He agreed with me that the coordination of all the science of the expedition ought to be in the hands of the scientific chief who had been selected, because his reputation was a guarantee that all interests would be properly looked after. Sir Michael Foster, to whom I mentioned the matter at a later date, quite agreed with this opinion, but was unwilling to contest the use of the term 'civilian.' Furthermore, when I raised the question at a meeting of the representatives of the Royal Society on the Joint Committee, it appeared that the term was actually preferred by certain influential naval authorities who were present, so that it was impossible to resist it without dividing those who desired to give Professor Gregory such a measure of freedom of action as he was prepared to accept.

At the meeting (November 20, 1900) of the Joint Committee, following the conversations with Professor Rücker and Sir Michael Foster, a report from the Executive Committee and submission and estimate from Captain Scott were read and received, with certain modifications. I indicated to the Secretaries of the Royal Society, who were sitting opposite to me, that this was a favorable opportunity to raise the question of the powers of the Scientific Director over the whole of the science of the Expedition. They were, however, unwilling to do so, hoping, I believe, that all difficulties would be smoothed away by personal negotiations between Captain Scott and Professor Gregory, who was expected home in a fortnight.

For nearly two months these negotiations proceeded between Professor Gregory on the one side and Captain Scott and Sir Clements Markham on the other, and between Sir Clements Markham and me.

The principles held were irreconcilable, and it only remained to appeal to the Joint Committee for a decision.

On January 9, 1901, Professor Gregory wrote to Professor Rücker, explaining the failure of the negotiations, and on January 28th he addressed a letter to the Royal Society's representatives on the Joint Committee, from which I select the following paragraphs:

> I landed at Liverpool on December 5, and went straight to Dundee to meet Captain Scott, and showed him a copy of my letter of January 19 [1900]. As he returned it to me next day without comment, I believed that he understood and accepted the general conditions therein stated. On January 7, in order to settle the exact terms of our mutual relations, I submitted to Captain Scott a draft of the instructions I expected to receive from the Joint Committee, and which I had previously shown to Professor Poulton. To my surprise Sir Clements Markham and Captain Scott expressed disapproval of these instructions, practically on the ground that there could be only

one leader of the Expedition, and that that leader must be Captain Scott.

My colleagues and myself were characterized as civilian scientific experts, accompanying the expedition to undertake investigations in those branches of science with which the ship's officers were unfamiliar, and it was proposed that, to maintain Captain Scott's complete control, all the scientific men should be required to sign articles.

According to this theory, the position of the scientific staff is accessory and subordinate. The contentions of Sir Clements Markham and Captain Scott would completely alter the position which I was invited to take and which alone I am prepared to accept. Were I to accompany the expedition on those terms there would be no guarantee to prevent the scientific work from being subordinated to naval adventure, an object admirable in itself, but not the one for which I understood this expedition to be organized.

The Executive Committee met on January 30th and drafted instructions on lines approved by Sir Clements Markham. They were opposed by my colleague Captain Tizard, but in my absence through illness were passed by two votes to one.

A few days later the draft instructions were considered by the Royal Society's representatives, who appointed Sir Joseph Hooker, Sir William Wharton and Sir Archibald Geikie to suggest amendments. They carefully considered the draft and suggested several alterations, the most important of these being the instructions to the commander, (1) not to winter in the ice, (2) to establish between two named points on the coast a landing party with three year's stores, under the control of Professor Gregory.

The Royal Society's representatives again met and unanimously approved these amendments, which were submitted together with the draft instructions to the meeting of the Joint Committee on February 8th. The representatives of the Royal Geographical Society objected that they had not had the same opportunity of considering the instructions at a separate meeting, and that the amendments were sprung upon them. The meeting was accordingly adjourned until February 12th, the very day before Professor Gregory sailed. During the prolonged discussion which took place, the authorities on magnetism were unanimous in affirming that a station on land was essential in order to obtain the full value of the observations made on the ship.

Sir Clements Markham threatened that the Council of the R. G. S. would not accept the amended instructions, whereupon Sir Michael Foster drew attention to the letter which Sir Clements had written at the time when the Joint Committee was proposed.

The amendments were finally approved by 16 votes to 6, and Sir Archibald Geikie and I were deputed to explain to Professor Gregory, who was in attendance, that he was to be landed in control of a small party, if a safe and suitable place could be found, and to ask if he would accept these conditions. We reported his consent to the meeting, which was then adjourned for the consideration of other details.

Two of the representatives of the R. G. S., Sir Anthony Hoskins and Sir Vesey Hamilton, resigned shortly afterwards, explaining that they could not agree with the action of the Committee. The R. G. S. had, however, the right, which it subsequently exercised, of appointing new members.

At the adjourned meeting, on February 19th, the question of the ship wintering was discussed at length. Those who had practical experience of the Antarctic urged us strongly not to take the responsibility of permitting the ship to winter in the ice. Sir Joseph Hooker's statement of the danger was especially impressive, and the meeting decided in accordance with his opinion.

At the same meeting Major L. Darwin proposed to modify the conditions accepted by Professor Gregory, by adding to them the additional consideration that he should only be landed if the time of the ship should not be too greatly diverted from

geographical exploration. I protested strongly against any modification at this stage. Sir Michael Foster opposed me, and, after the close of the meeting, there was a somewhat sharp though friendly expression of conflicting opinions, he maintaining that there should be 'give and take,' I that we were already pledged to Professor Gregory, that the arrangement was as it stood a compromise—the minimum Professor Gregory would accept—by no means the one which scientific men, not belonging to the navy, would have preferred.

At that meeting Major Darwin did not succeed, but his suggestion in somewhat different words was again brought forward at the next meeting on March 5th. Just before the meeting Sir Archibald Geikie told me that he intended to support the proposed changes 'in the interests of peace,' and that Mr. Teall, and Mr. George Murray, Professor Gregory's representative, also approved them. Resistance was hopeless; I could only protest against any alteration of the conditions offered and accepted, requesting that my name and the names of those who agreed with me (Mr. J. Y. Buchanan and Captain Tizard) should be recorded.

I wrote to Professor Gregory a full account of what had happened, carefully explaining that his representative and many of his friends supported the changes, that I had confidence that the proposal was made to enable the Geographical Society to accept the instructions and that it was not intended to prevent, and, I believed, would not prevent, his being landed.

In spite of the incorporation of Major Darwin's changes the R. G. S. Council refused to accept the instructions, but addressed a letter signed by their President, dated March 18th, to the members of the Joint Committee stating that they were compelled, "as trustees for the money subscribed through their Society and for the funds voted by their Society, to regard the above scientific objects [viz., those to be carried out by a landing party] as subsidiary to the two primary objects of the Expedition—namely, exploration and magnetic observations." In view of the unanimous witness of all experts that the landing party was *essential* for full success in the magnetic work this statement is sufficiently remarkable.

The letter went on to inform us that the President, Sir Leopold McClintock, and Sir George Goldie had interviewed the officers of the Royal Society and had reported to the R. G. S. Council which now suggested that the Joint Committee should recommend a small committee of six, three to be appointed by each Council, to deal finally with the instructions. The Council of the R. G. S. agreed to accept the decision of this committee provided the Council of the Royal Society agreed to do the same.

It has been stated in various directions that the Geographical Society produced new evidence (based upon the experience of Borchgrevink and the intentions of the German leader) which had not been laid before the Joint Committee, and thus induced the officers of the Royal Society to agree to a new committee. To this it may be replied that these sources of information had been open to the Joint Committee, and that, if anything new had arisen, it was reasonable to refer it to the old committee rather than to a new one appointed *ad hoc*. Furthermore, the letter of the Royal Geographical Society, referred to above, clearly indicated that the real intention was to escape from the conditions proposed to and accepted by the Scientific Leader.

The Joint Committee met on April 26th, and was addressed in favor of the course proposed by the R. G. S. Council by Sir George Goldie. Nothing was said which could diminish the conviction that the R. G. S. Council and that of the R. S. in weakly

consenting to nominate a fresh committee had struck a disastrous blow at all future cooperation between scientific bodies in this country.

What reply could the officers make if they were asked to advise the Council of the Royal Society to cooperate with that of the Royal Geographical Society on any future occasion?

I felt justified in asking what guarantee was there that the Council of the Royal Geographical Society would accept the finding of the committee of six, when it had refused to accept that of a committee which included all the officers and almost every expert in Arctic and Antarctic exploration from both societies. In reply Sir Michael Foster, in spite of the promise of firmness held out by his attitude on February 12th, when Sir Clements Markham threatened that his council would repudiate the finding of the Joint Committee, maintained that they had only acted within their rights, and that the Royal Society Council claimed the right to do the same if it had not agreed with the decision.

At this point it will be convenient to give a list of the representatives of the Royal Society on the Joint Antarctic Committee, the representatives of the Royal Geographical Society being equally significant in relation to the council of their own society. They are the President, the Treasurer, the Senior Secretary, the Junior Secretary, Mr. A. Buchan, Mr. J. Y. Buchanan, Captain Creak, Sir J. Evans, Sir A. Geikie, Professor Herdman, Sir J. D. Hooker, Professor Poulton, Mr. P. L. Sclater, Mr. J. J. H. Teall, Captain Tizard, and Admiral Sir W. J. L. Wharton.

If the reports of Joint Committees of such magnitude and weight are to be thrown over with the approval of the councils of both societies because a majority of one council does not agree with the conclusions, men will rightly hesitate before consenting to devote an immense amount of time and trouble to the work of the Society, and the efficiency of the Royal Society will be greatly diminished.

The considerations set forth above indicate the future injuries which are likely to be inflicted on our Society by this surrender. At the meeting on April 26th, I was more concerned with the immediate and pressing injury, and therefore urged that the Royal Society was a trustee for the interests of science and that we had pledged ourselves to secure certain powers to the Scientific Director, that it was better the expedition should not start (a contingency contemplated as possible by Sir George Goldie, but not a serious danger, I believe, even though the Royal Society had stood firm and appealed to the Government, not on the subject-matter in dispute, but on the refusal of the Royal Geographical Society to work with the recognized methods of cooperation) than that the Royal Society should betray its trust, that the fellows of the Society would not support the officers in thus yielding to the Royal Geographical Society, and that I should feel bound to explain my position to the Society. Sir Archibald Geikie and Mr. J. Y. Buchanan also strongly objected to the surrender, which was then confirmed by a large majority of those present.

We were told by Sir George Goldie that the three representatives of the Royal Geographical Society on the new committee would be Sir Leopold McClintock, Mr. Mackenzie, and Sir George himself; by Sir Michael Foster that the Royal Society Council would appoint three non-experts, viz.: Lord Lister, Lord Lindley and the Treasurer, who could pronounce without bias upon the whole of the evidence. My colleague, Captain Tizard, with whom I had worked with the most complete sympathy and agreement through the whole course of the negotiations, supported the

formation of the new committee, because of Sir Michael's assurance that all evidence would be sifted and because of his faith in the validity of the evidence he had to give. Others probably voted in the affirmative for the same reason.

Without asking for evidence from Sir Joseph Hooker, Sir W. Wharton, Sir George Nares, Sir A. Geikie, Captain Creak, Captain Tizard or Mr. Buchanan, the new committee proceeded to cable to Melbourne the modifications which have led Professor Gregory to resign.

In bringing a condensed account of the negotiations before the Fellows of the Royal Society I desire to call attention to certain special difficulties which the Society has had to encounter in the struggle.

(1) The fact that nearly the whole of the money voluntarily subscribed was obtained through members of the Geographical Society and from its funds.

(2) The fact that Sir Clements Markham, President of the Royal Geographical Society, a man of remarkable energy, resource and resolution, was the chief antagonist of the amendments passed by the Joint Committee.

(3) The fact that the Junior Secretary and Sir John Evans were absent from England during the most critical period.

(4) Professor Gregory's appointment to the Chair at Melbourne, involving his absence from England during a large part of the negotiations.

Making all allowance for these difficulties, I believe that the majority of the fellows will consider that the claims of the scientific chief in an expedition undertaken to do scientlfic work have not received from the Royal Society that unflinching, undivided and resolute support which they would have expected and desired.

EDWARD B. POULTON.

OXFORD, May 15, 1901.

FIRST REPORT OF THE LIMNOLOGICAL COMMISSION OF THE AMERICAN MICROSCOPICAL SOCIETY.

THE initial report of a body so recently organized as this can hardly be more than preliminary in character, all the more so that the field entrusted to it is as extensive as untried. When, by the action of this Society a year ago, the Limnological Commission was organized and its members asked to assume the duties laid upon them in connection therewith, they accepted, not without some hesitancy at the extent of the work before them. The study of fresh-water bodies is indeed a great field, barely touched upon at one or two points in this country, and nowhere in the world even superficially covered as yet. Nevertheless it was the original field of biologic study; it was and is accessible to public and private workers practically everywhere, and affords opportunities for extended or limited work in any particular department of biologic research towards which the student may be drawn. Furthermore, to this work attaches an undoubted interest for all who come within its territory, while its problems have not only great biologic importance, but are also of economic value as well as of decidedly practical character, touching as they do upon the important questions connected with fish culture, municipal water supply and sewage disposal.

In this first report it will not be possible to do more than outline succinctly what has developed from our correspondence and discussion thus far regarding the object of the work, to make a brief survey of the field under discussion, of the ends to be reached and of some of the means for attaining them, and finally to invite propositions concerning the methods and problems under consideration and cooperation in proceeding toward their solution.

It may be fitting at the outset to state briefly the outlook before the Commission. Such a venture as this is not entirely unheard of and consequently venturesome. A similar body was appointed some years ago by the Swiss National Society of Natural Sciences. As a Swiss investigator,

Professor Forel, of Geneva, was the pioneer in the study of fresh-water lakes, and, as the investigators of this beautiful mountain republic have retained their supremacy in this field of research through more than thirty years, so also Switzerland was the leader in organized effort towards the development of limnological investigation. The plan of the Swiss Limnological Commission in assigning work in various regions to different students has met with such success as to inspire those who follow in its footsteps with hope for the outcome of their efforts, and as to hold up a high standard for their attainment. Similar results cannot be expected in a brief period of time, but we hope that they may be reached here eventually.

The study of limnologic questions affords abundant opportunities for workers of every type and of every grade; but if the results of such varied activity are to be of permanent value or of general import they must be correlated and unified. Therewith gaps in the records will become apparent and new problems will be suggested, so that the lines of work will be extended and at the same time joined together into a symmetrical system. The fundamental objects then of this Limnological Commission we believe to be:

To coordinate the results obtained by different investigators into a united whole, to enlist new workers and to encourage new work along lines already marked out, to suggest new lines of work and methods of research, and to aim at uniformity of procedure, so that the results may be compared and correlated.

For convenience in discussion and in the organization of the work, the field of limnologic study has been cut up into a number of main divisions and some of the chief subdivisions under each indicated. These are as follows:

1. Bibliography: A general historical review of limnological studies to date; periodic summaries of work done in the world at intervals thereafter.

2. Physiography: The inanimate environment, including the physical and chemical study of water bodies; types of such bodies, distribution; temperature, color, circulation; lake areas; composition of water, etc.

3. Biology, (*a*) Taxonomy of water organisms: Systematic tables, description and sketch of each on cards to form eventually a faunal catalog for the United States. (*b*) Morphology of organisms: Anatomy, histology, embryology of individual forms. (*c*) Distribution of organisms: Geographic; regional; littoral, limnetic, bathybic species; quantitative: General, numerical, proportional. (*d*) Physiology, experimental studies. (*e*) Ecology.

4. Applied limnology: Water supply, sewage, fish culture.

After this preliminary statement, the Limnological Commission has the following recommendations to make for the purpose of advancing this work:

First, it is expedient that as soon as suitable persons can be found who are willing to undertake the work, there should be added to the Commission a physicist, a chemist and a bacteriologist, in order that these phases of the environment may be adequately studied.

Second, the influence of the Society should be directed towards the production and publication of accurate systematic accounts of the fresh-water organisms to the end that the various workers on limnologic questions may have at hand taxonomic summaries of the organisms with which they come in contact. It is not too much to say that such treatises are non-existent for American forms and inaccessible to the majority, even for the few groups which have been partially worked out. This must be the first step in the inauguration of the proposed movement. The publication of a series of

catalog cards, each devoted to a single species, appears as a desirable method of putting such data into accessible form and keeping them in shape for frequent emendation or addition.

Third, in the interest of a complete knowledge of the distribution of fresh-water organisms, the Commission plans the keeping of careful faunal records. It is proposed to appoint one or two investigators for each group, who shall undertake to enter and collate all faunal records of this group which may be sent them and conversely to furnish workers with information concerning the distribution of such organisms. This plan will ultimately yield data for the discussion of the geographical distribution of fresh-water genera and species. It will also enable the elimination of such data as are common, leaving for publication by the student those facts which are important for one reason or another.

Fourth, the Commission is of the opinion that an occasional summary of progress in the field of limnology will serve to keep students in touch with the subject by giving them knowledge of the work of the world in general. This is that subdivision of the field which stands first in the outline given above. It has been covered sufficiently for the present by the summary and review printed in the *Transactions of the American Microscopical Society*, Vol. XX., bringing the subject up to January, 1899.

Fifth, the Commission would most strongly advise that individual work should be limited to a single body of water or to a definite problem studied with reference to a series of such water bodies. The results will be most useful for all purposes when they bear upon the thorough treatment of a single phase of the subject rather than more indefinitely upon a wider field.

There is naturally involved in the effort to carry out such plans as have been outlined some expenditure of money, even if the services of various investigators are freely and gratuitously placed at the disposal of the Commission. Accordingly, an appeal is made herewith to the generosity of those interested in the movement and in the development of biological study in our country for contributions, large or small, for the prosecution of this work.

In conclusion, all students interested in this subject are invited to participate in the work. It is by general and generous cooperation that success will be attained. The student who is working alone cannot advance far, unless brought in touch with others in the same field. It may be noted that the opportunity is peculiarly advantageous for those teachers in smaller colleges who can make use of a corps, even of untrained assistants, in the collection of various data. We feel it a privilege to invite kindly criticism of this report and suggestions as to the best means for carrying out the aims in view and for securing the cooperation of the largest number of workers.

(Signed) A. E. BIRGE, *Chairman.*
C. H. EIGENMANN,
C. A. KOFOID,
G. C. WHIPPLE,
H. B. WARD, *Secretary.*

NORTH CAROLINA SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular meeting of the North Carolina Section of the American Chemical Society was held in the State chemist's office, Agricultural Building, Raleigh, on April 27, 1901, at 11 A. M., with Professor Kilgore in the chair. Twenty-seven members and visitors were present.

The annual election of officers for the ensuing year were:

W. A. Withers, President; W. J. Martin, Jr., Vice-President; C. B. Williams, Secretary-Treasurer; Charles Baskerville, Representative in Council of the American Chem-

ical Society; Executive Committee, W. A. Withers, W. J. Martin, Jr., and C. B. Williams.

The following program was presented and discussed:

'Basis of Scientific Thought,' by Charles Baskerville.

'The Chemical Composition of Cotton Seed Meal,' by W. A. Withers and G. S. Fraps.

The authors found that the average amount of betain and cholin in seven samples of cotton-seed meal was 0.28 per cent., the ratios being (the average of two samples) betain : cholin :: 78.5 : 21.5. Gossypein if present is in minute quantity. Of the nitrogen-free extract 29.2 is pentosans, and 47.4 per cent. raffinose.

The pentosans of the meal are insoluble in diastase and are contained entirely in the nitrogen-free extract, unless an unusually large amount of hulls is present.

Cotton seed meal contains no starch and no appreciable quantities of sucrose or of reducing sugars. The average of five samples gave 0.48 per cent. of organic acids.

'The Recent Advances in Physiological Chemistry,' by A. S. Wheeler.

'Alcohol as an Antidote for Carbolic Acid,' by E. V. Howell.

1. In this paper attention was called to the fact that experiments by the author, beginning early in 1899, show that alcohol removes the escharotic effect of carbolic acid on the arm and in the mouth. 2. That, on account of the alarming increase in its use for suicidal purposes and the large number of accidents because of its general use as a disinfectant, carbolic acid should be scheduled as a poison in the poison laws of the various States and its sale restricted. 3. That alcohol is on record as an antidote and the results demand a thorough investigation. It must act most probably in one of three ways: (*a*) As a simple addition to counteracting the escharotic effect; (*b*) as a chemical antidote, forming an inactive or less active compound; (*c*) as a physiological antagonistic, its stimulating effect combating the depressant effect of the phenol. In investigations being carried on, so far no chemical reaction between carbolic acid and alcohol, or carbolic acid and camphor (which also removes the escharotic effect) has been observed.

'The Presence and Detection of Arsenic in Beer,' by W. Grimes Haywood.

This paper was a review of the recent cases of poisoning in England, due to the presence of arsenic in beer, and a comparison of the methods for the determination of that element.

'A New Meteoric Iron from Davidson county, North Carolina,' by Joseph Hyde Pratt.

This iron was found on a hillside rising just east of Lexington—Troy road, about a half-mile south of Cid P. O., Davidson County. The iron originally weighed 13 lbs. 14 oz., and was somewhat oblong in shape and its surface more or less pitted. Testing the polished surface failed to reveal either the Widemannstattian figures or the Neumann lines; but the etched surface presents a granular or stippled appearance overlain with a network of fine lines, and the fractured surface shows traces of what is apparently an octohedral cleavage. This etched surface, while being different from the other meteorites, is also different from any of the manufactured irons that have been tested. An analysis by Dr. Baskerville gave: iron, 93.89; manganese, .92; nickel, .30; cobalt, .34; silicon, .62; carbon, 3.88; but sulphur, phosphorus, titanium, aluminum and copper were absent. Dr. Pratt claims that the presence of nickel and cobalt and the absence of sulphur, phosphorus, etc., together with its structure and the more or less isolated country in which it was found, lead to the belief that this iron is of me-

teoric origin. The name proposed for it is the Cid Iron.

'Ulsch-Street Method modified to include Organic Nitrogen in Samples containing Nitrates and Chlorides,' by W. M. ALLEN.

The author recommends the following: Place 0.7 gram sample in 250 cc. Kjeldahl digesting flask. Add about 1 gram of reduced iron, 30 cc. water and 10 cc. dilute sulphuric acid (1 to 1). Shake well and let stand 15 or 20 minutes. Heat slowly, so that solution will boil gently for 10 or 15 minutes, then briskly, until two-thirds of water has boiled off. Cool slightly, add 25 cc. sulphuric acid and 0.7 gram mercuric oxide. Digest and distill, as in Kjeldahl method. In samples of pure nitrate, add 0.5 gram of ferric chloride to the water to dissolve first nitric oxide set free, and digest only for the nitric nitrogen. The presence of large amounts of iron salts must be guarded against or else violent bumping will give trouble in distillation.

'The Nature of Pentosoids and their Determination,' by G. S. FRAPS.

The author divides pentosoids into water-soluble, acid-soluble, soluble in cold caustic soda solution ('wood gum') and difficultly soluble. Members of the first three classes have been hydrolized to pentose, and are called pentosans. The last class includes lignocelluloses, oxycelluloses, etc., and have not been hydrolized to pentoses. The crude furfural from vegetable materials obtained in the pentosan determination was found to contain a body which is precipitated by phloroglucol and destroyed by distillation with hydrochloric acid. Its occurrence, distribution and digestibility were discussed and the effect of its presence on the pentosan determination.

'An Automatic Filter-Washer,' by J. M. PICKEL.

This apparatus consists of (1) a reservoir for water with which to wash; (2) a rubber tube, provided with thumb-screw clamps, leading from the reservoir to the (3) delivery vessel, which, by means of a small siphon, delivers the water intermittently on to the filter; (4) a funnel containing the filter and, set in this funnel, a smaller inverted funnel; (5) means for disposing of the washings. When once set going the apparatus needs no further attention, and is especially applicable in determining water-soluble nitrogen in fertilizers and also water-soluble phosphoric acid (although not yet in use for this latter purpose).

'Notes on the Latent Heat of Vaporization of Liquids,' by J. E. MILLS.

'Notes on the Determination of Insoluble Phosphoric Acid,' by C. D. HARRIS.

Mr. Harris exhibited an arrangement which had proved, in his hands, very satisfactory in filtering and washing citrate-insoluble phosphoric acid. He substitutes a carbon filter in the bottom of which is a porcelain disc covered with asbestos, for the slow and hazardous method of using a funnel and hardened filter paper.

'Contribution to the Chemistry of Thorium; Evidence pointing to the Existence of a New Element, Carolinium,' by CHAS. BASKERVILLE.

The author has obtained thorium salts from five different sources and purified them. By the action of sulphur dioxide on the neutral chlorides and by fractioning the citrates, oxides are eventually obtained which indicate the complexity of thorium. The pure oxide has a specific gravity of 9.8, according to some authorities, and 10.2, according to others. The purified oxide mentioned had a specific gravity of 10.1; after fractioning, one had a specific gravity of 9.4 and the other 10.37; intermediate fractions gave 9.6 and 10.4. Although atomic weight determinations have not been made, there is much evidence in favor of the existence of a new element, which the author would name 'Carolinium.' To avoid criticism the author stated his ex-

cuse for presenting the paper before the work was completed. Having made these observations quite four years ago, in the interim he has been engaged in securing direct from monazite sufficient quantity of pure thorium salts. Five thousand liters of solution have been worked up. The author's supply of the element has been much augmented through the kindness of Dr. Waldron Shopleigh, of the Welsbach Light Company, who presented him with two kilograms of his purest thorium oxalate. Last fall the author wrote Professor Bohnslar Brauner, of Prague, who had made the most recent atomic weight determinations of thorium, about his experiments. Not hearing from Dr. Brauner, the author was surprised to see in the *Proceedings of the London Chemical Society*, April 10, 1901, an article on 'Contributions to the Chemistry of Thorium' by Dr. Brauner, in which he states that he had fractioned thorium by hydrolysis of the oxalate into two bodies which he terms $Th\alpha$ and $Th\beta$. Brauner's work as reported was by no means complete. While the author insists that he holds the very highest opinion of Professor Brauner, and while neither his work nor the motives prompting Professor Brauner in making this preliminary publication are called into question, in justice of the author's work along these lines, it was not deemed unscientific to present the results of incomplete observations.

'The Systematic Investigation of Soils,' by B. W. Kilgore.

After the transaction of some miscellaneous business the Section adjourned to meet in the summer.

C. B. Williams,
Secretary.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

We publish below a list of those who have been elected members in the Association and have completed their membership during the month of May.

Albree, Chester B., Mechanical Engineer, 14–30 Market Street, Allegheny, Pa.

Allan, Chas. F., Newburgh, N. Y.

Baldwin, Hon. Simeon E., Associate Judge of Supreme Court of Errors, New Haven, Conn.

Beach, Harry W., Manufacturer, Montrose, Pa.

Bethel, Ellsworth, Director, Department of Botany, Academy of Science, 271 Grant Ave., Denver, Colo.

Booth, Edward, Instructor of Chemistry, 1214 Harrison St., Oakland, Cal.

Brasefield, Prof. Stanley E., Professor of Mathematics, 327 Centre St., Easton, Pa.

Braunnagel, Dr. Jules L. A., Physician and Surgeon, P. O. Box 925, San Antonio, Texas.

Brown, Elisha R., President Stafford Savings and National Banks, 50 Silver St., Dover, N. H.

Bush-Brown, Henry K., Sculptor, Newburgh, N. Y.

Capp, John A., Mechanical Engineer, Schenectady, N. Y.

Carnegie, Thomas Morrison, Trustee of Carnegie Institute, Dungeness, Fernandina, Fla.

Chauvenet, Wm. M., Mining Engineer, 620 Chestnut St., St. Louis, Mo.

Clapp, D. C., Steel Manufacturer, 718 Amberson Ave., Pittsburg, Pa.

Clark, John J., Dean of Faculty, International Correspondence Schools, P. O. Box 534, Scranton, Pa.

Cleaver, Albert N., Manufacturer, South Bethlehem, Pa.

Clerc, Frank L., Professor of Metallurgy and Assaying, Colo. State School of Mines, Hotel Metropole, Denver, Colo.

Coit, Joseph H., St. Paul's School, Concord, N. H.

Cooper, James C., Tax Commissioner C. K. I. & S. P. R. R. Co., Room 5, Veale Block, Topeka, Kansas.

Cox, Prof. Ulysses O., Professor of Biology, State Normal School, Mankato, Minn.

Cummins, G. Wyckoff, Practicing Physician, Belvidere, N. J.

Currier, Mrs. Moody, Myrtle & Ash Sts., Manchester, N. H.

Dempster, Alexander, Engineering, Stanton & Euclid Aves., Pittsburg, Pa.

DuBois, Howard W., 4526 Regent St., Philadelphia, Pa.

Engler, Dr. Edmund A., President-elect Worcester Polytechnic Institute, Washington University, St. Louis.

Farquhar, Miss Helen, Teacher of Geometry, Algebra and Physics, Moravian Seminary, Bethlehem, Pa.

Frost, George H., Editor of *Engineering News*, 220 Broadway, New York City.

Galbraith, Prof. John, School of Practical Science, Toronto, Canada.

Graham, James C., Chemist, Phillips Academy, Andover, Mass.

Granville, Dr. Wm. A., Instructor in Mathematics, Yale University, 7½ Elm St., New Haven, Conn.

Grimes, Prof. James S., 122 Wesley Ave., Evanston, Ill.

Gold, Rev. Dr. James Douglas, Covington, Miami Co., Ohio.

Hall, Robert W., Biology, 2 Hillhouse Ave., New Haven, Conn.

Halsted, William Stewart, 1201 Eutaw Place, Baltimore, Md.

Hamaker, Prof. John I., Professor of Geology and Biology, Trinity College, Durham, N. C.

Harrison, Dr. Robert Henry, Practising Physician, Columbus, Colorado Co., Texas.

Henrich, Carl, Mining Engineer, Care of Union Copper Mining Co., Gold Hill, N. C.

Herr, Hiero B., Civil and Mining Engineer, 1246 Marquette Building, Chicago, Ill.

Herschberg, Hon. Michael H., Judge of Supreme Court, State of New York, Newburgh, N. Y.

Hill, Ebenezer, Treasurer, Norwalk Iron Works, South Norwalk, Conn.

Hillkowitz, Dr. Wm., Physician, 704 Race St., Cincinnati, Ohio.

Holmes, Frederic Harper, Instructor in Physics, Geography and Mathematics, State Normal School, Hyannis, Mass.

Hoobler, Bert R., Botanist and Zoologist, Wabash College, Crawfordsville, Ind.

Hooker, Donald R., Chemist, 436 Orange St., New Haven, Conn.

Hooper, Alcaeus, 710 Merchant's Bank, Baltimore, Md.

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Howland, Howard N., Lake Forest, Ill.

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Kendall, Hugh F., Mining Engineer, Care of Pittsburg & Lake Angeline Iron Co., Ishpeming, Mich.

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Kops, Julian de B., Civil Engineer, Savannah, Ga.

La Fetra, Dr. Linnaeus E., Physician, 58 West 58th St., New York City.

La Rue, Wm. G., Mining, North Freedom, Sauk Co., Wis.

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Macdonald, Benjamin J., 296 Grand St., Newburgh, N. Y.

Marble, Milton M., Instructor in Physics, Hillhouse High School, New Haven, Conn.

Marvin, Walter T., Philosophy and Psychology, 39 Knox St., Cleveland, Ohio.

McKelvy, Dr. Wm. H., President Board of Education, 420 6th Ave., Pittsburg, Pa.

Morton, James F., Andover, N. H.

Negley, Henry H., Botanist, 600 N. Negley Ave., Pittsburg, Pa.

Ness, Prof. Helge, Botanist, A. & M. College, College Station, Texas.

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Palmer, Dr. Charles S., Professor of Chemistry, University of Colorado, 1224 Pine St., Boulder, Colo.

Perkins, Albert S., Teacher of Chemistry, 75 Milton Ave., Hyde Park, Mass.

Platt, Dr. Walter B., Physician, 802 Cathedral St., Baltimore, Md.

Porter, Henry K., Trustee of Carnegie Institute, 541 Wood St., Pittsburg, Pa.

Rice, John A., Mining Engineer, Bland, Bernalille Co., New Mexico.

Richards, Alfred N., 45 West 60th St., New York City.

Richards, Prof. Charles R., Professor of Mechanical Engineering, Univ. of Nebraska, Lincoln, Nebr.

Roe, Edward Drake, Jr., Associate Professor of Mathematics, Syracuse Univ., 105 Anna St., Syracuse, N. Y.

Schweinitz, E. A. de, M.D., U. S. Dept. Agriculture, Washington, D. C.

Scott, William, Attorney-at-Law, 450 4th Ave., Pittsburg, Pa.

Sedgwick, Prof. Wm. T., Mass. Inst. Technology, Boston, Mass.

Shaw, Wilson A., Cashier Merchants' and Manufacturers' National Bank, Norwood Ave., cor. Forbes Ave., Pittsburg, Pa.

Sherman, Dr. Lewis, Physician, 448 Jackson St., Milwaukee, Wis.
Sherman, Franklin, Jr., State Entomologist, Raleigh, N. C.
Shropshire, Dr. Walter, Physician, Yoakum, DeWitt Co., Texas.
Silvester, Richard W., President, Maryland Agricultural College, College Park, Md.
Smith, Arthur, Lawyer, 152 Broadway, New York City.
Smith, Henry L., President, Davidson College, Davidson, N. C.
Smith, Miss Jennie M., 803 Arch St., Allegheny City, Pa.
Smith, Miss Matilda H., 803 Arch St., Allegheny City, Pa.
Smith, Miss Sara Winthrop, Botanist and Anthropologist, Nantucket, Mass.
Smith, T. Guilford, Civil Engineer, Regent University State of New York, P. O. Drawer, Buffalo, N. Y.
Snedaker, James A., Mining Engineer, 721–722 Equitable Bldg., Denver Colo.
Stevens, Edwin A., Mining Engineer, Victor, Colo.
Stevens, Geo. T., 33 West 33d St., New York City.
Stewart, Douglas, Mineralogist, Carnegie Museum, Pittsburg, Pa.
Stokes, Anson Phelps, 47 Cedar St., New York City.

Taylor, Edward B., Engineering, Pittsburg, Pa.
Thaw, Benjamin, President Hecla Coke Co., Morewood Place, Pittsburg, Pa.
Thomas, Dr. George T., Physician, Rogers, Texas.
Thompson, William, Mining, Metallurgical and Mechanical Engineer, care of Rossland Great Western Mines, Ltd., Rossland, B. C.
Thornber, John J., Botanist, 1217 Third Ave., Nebraska City, Nebr.

Vaile, Joel F., Lawyer, Denver, Colo.
Van Ornum, Prof. John Lane, Professor of Civil Engineering, Washington University, St. Louis, Mo.
Veeder, Curtis H., Mechanical Engineer, 40 Willard Street, Hartford, Conn.

Waterhouse, Prof. James S., Professor of Chemistry and Natural Science, Cumberland University, Lebanon, Tenn.
Weston, Wilbur H., Newburgh, N. Y.
Wilcox, William W., Inventor and Manufacturer, 187 South Main St., Middletown, Conn.
Williams, Dr. J. Whitridge, Professor of Obstetrics, Johns Hopkins University, 1128 Cathedral St., Baltimore, Md.
Wills, J. Lainson, F.C.S., Chief of Laboratories, National Brewers Academy, 133 Midwood St., Brooklyn, N. Y.
Woodworth, C. W., Assistant Professor of Entomology, Univ. of California, Berkeley, Cal.

York, Lewis E., Supt. Public Schools, Kingsville, Ohio.

SCIENTIFIC BOOKS.

THE MESOZOIC FLORA OF THE UNITED STATES.*

The great activity in paleobotanical research which characterizes the work of the U. S. Geological Survey finds renewed expression in the recently issued 'Status of the Mesozoic Floras of the United States,' by Professor Ward, with the collaboration of Professor W. M. Fontaine, Mr. Atreus Wanner and Dr. F. H. Knowlton. Without attempting a republication of results which have already appeared, the author aims to present a 'succinct account of the progress thus far made in the direction of developing the Mesozoic Floras of the United States,' enumerating for the several formations, geographical areas and special localities the fossil plants that have been found, and also giving a complete bibliography of the work accomplished, with special reference to correlation. Questions of expediency have necessitated a division of the work into two parts. The first of these to which our attention is now directed discusses the Older Mesozoic, while the second part will deal with the Younger Mesozoic or Cretaceous.

The Triassic flora is represented by a description of seventy-six species or forms, of which nineteen are recorded for the first time, and among these latter is to be noted the name of a new genus—*Yorkia*—which has been given by Mr. Wanner and provisionally adopted by Professor Ward to identify a possible grass which is not very clearly defined as such by the figures given, although the latter are very suggestive of a plant of Monocotyledonous type which serves to recall the *Poacites* of Saporta.

The incompleteness of the paleobotanical

* Ward, Lester F., Status of the Mesozoic Floras of the United States. The Older Mesozoic. Second Annual Report of the U. S. Geol. Surv., 1898-99. Washington, 1900. Pp. 215-430. Plates XXI.-CLXXIX.

record, especially with respect to the earlier periods, and the uncertainty which exists relative to precise limitations as defined by the vegetation, lead the author to treat the American Trias as a geographical unit, between which and any of the recognized European series it has as yet been impossible to establish exact correlation, but it is worthy of remark that not only are the plants of the European Trias most numerous in the uppermost number of the series, *i. e.*, in the transition beds or the Rhetic, but that all the fossil plants of the American Trias have their nearest affinities in Europe, with those of the latter formation.

The principal plant-bearing deposits of the American Trias are to be found in the Connecticut Valley, near Richmond, Virginia, and in North Carolina. They are also extensive in New Mexico and Arizona, extending into Utah, Nevada and Colorado, and probably also into the Indian Territory and Texas. They also appear in California in the well-known beds at Oroville. The Pennsylvania area was very carefully studied by Mr. Wanner, whose material was revised by Professor Fontaine, and for a total of thirty-one species shows Filices 10, Equisetaceæ 1, Cycadaceæ 10, Bennettitaceæ 1, Ginkgoales 1, Coniferæ 7 and Monocotyledons (?) 1.

In the Virginia area the work of Professor Fontaine led Dr. Stur, of the Austrian Geological Survey, to identify many of the species with plants from the European Keuper, whence he concludes that the Trias of Virginia and that of Lunz are of the same age.

The most complete and noteworthy collection of plants from the older Mesozoic is that of Dr. Emmons from North Carolina, deposited in the museum of Williams College, where they were subsequently studied by Professor Fontaine with the result that it was found to contain Filices 10, Equisetaceæ 2, Cycadaceæ 14, Bennettitaceæ 1, Ginkgoales 1, Coniferæ 6 and of doubtful affinity 4, in a total of thirty-eight forms. Comparing this list with that obtained from Pennsylvania, a remarkable correspondence between the representatives of the different familes is here noted.

One of the most notable features of the southwestern area is to be found in the very abundant remains of trees which have become silicified and form the well-known 'Petrified Forest of Arizona.' These remarkably well preserved remains have already been fully described in a special memoir by Professor Ward, and they are now dealt with only so far as is necessary to connect them with the special subject under discussion. The wood has been identified by Knowlton as that of *Arancorioxylen Arizonicum*.

The Jurassic flora embraces a description of fifty-two species, of which three only are recorded for the first time. About half of these species are embraced in the Oroville flora of California and include Filices 13, Cycadaceæ 10, Ginkgoales 1, Coniferæ 3 and unknown 1; while the remaining twenty-four from the Jurassic of Wyoming represent Cycadaceæ 22, Coniferæ 2.

Of the 28 species in the Oroville flora, only 12 are to be regarded as of definite value in the determination of geological age. Of these *Cladophlebis spectabilis*, *C. arguluta*, *C. whitbiensis tenuis* var. *a*; *Thyrsopteris Maakiana*, *Podozamites lanceolatus*, *P. lanceolatus latifolius* and *Pinus Nordenskioldi* were determined by Heer to be characteristic of the Jurassic in a horizon equivalent to the Lower Oolite of Scarborough, whence it becomes of special interest to observe that Seward * refers to the occurrence of *Cladophlebis whitbiensis*, *Thyrsopteris Maakiana* and *Podozamites lanceolatus*. *Cladophlebis whitbiensis* he now recognizes as properly identical with *Todites Williamsoni* of Brongniart, a species of wide distribution in the Jurassic of Europe, Greenland and Siberia and characteristic of the Yorkshire Oolite. *Thyrsopteris Maakiana* he identifies with *Coniopteris hymenophylloides*, which occurs in the Jurassic of Siberia and also constitutes one of the most characteristic species in the Oolite of the Yorkshire Coast. *Podozamites lanceolatus* has an exceptionally world-wide distribution, and is especially characteristic of the Jurassic strata. The *Pagiophyllum* type of conifer which is highly characteristic of the Jurassic, is represented in the Oroviile series by *P. Williamsoni* as the only conifer of importance; while in Europe and China, as also in the

* 'Catalogue of Mesozoic Plants,' British Museum, 1900.

Yorkshire flora, it is a characteristic element of the lower Oolite.

Sagenopteris Nilsoniana, while found in the Oroville flora, is most characteristic of the Rhetic, and it does not occur in the Yorkshire Oolite, where its nearest representative is *S. Phillipsi* of Brongniart. Its reference to the Oroville horizon is regarded by Ward with some doubt, hence it can not be held to have much weight as a factor in determining age.

The author concludes his valuable contribution by a tabular view of the distribution of 188 separate forms of Lower Mesozoic plants, showing their relation to the various North American areas both of the Triassic and Jurassic formations. He thereby gives emphasis to the fact that remarkably few species (three) are common to both formations, while even the majority of these are open to question. A comparison of the flora of the Yorkshire Oolite with the Jurassic of North America shows that with respect to the Filices and the Coniferæ there is a close correspondence in relative number of representatives, but that in the North American Jurassic there is a pronounced preponderance of the Cycadaceæ. In the latter flora also, both Bryophyta and Equisetales appear to be wanting.

	Inferior Oolite of Yorkshire.	North American Jurassic.
Bryophyta,	1	0
Equisetales,	2	0
Filices,	20	15
Cycadales	23	30
Coniferæ,	9	7

D. P. Penhallow.

Montreal, May, 1901.

Steam-boiler Economy. A Treatise on the Theory and Practice of Fuel Economy in the Operation of Steam-Boilers. By William Kent, A.M., M.E. New York and London, John Wiley & Sons and Chapman & Hall. 1901. 8vo. Pp. xiv + 458. Price, $4.00.

This is a work, by an authority in its field, devoted to the study, theoretical, practical and experimental, of steam-boiler economics. Its author has had a long and varied experience of the most valuable kind in this department of mechanical engineering and in related fields of work, study and research. To this peculiarly happy practical and theoretical acquaintance with this subject he has added a singularly exceptional talent for the work and an unusually thorough technical preparation for its prosecution. Large experience, as an author and as an editor, and in the preparation of professional reports as expert in this and related matters, has given him the ability to digest, to formulate and to logically plan and execute a piece of technical work of high grade. The outcome of his endeavor is an exceptionally condensed, complete and exact treatise. The author has also confined himself very closely to his restricted title, and the reader will find there precisely what he seeks.

The book is not only well constructed, but it adds to existing knowledge, as presented in the text-books and special treatises as commonly written, some very valuable novelties which have peculiar interest to the professional man and the student. For example, maps are given of the coal-fields of the country and the distribution of the fossil fuels is exhibited clearly; while accompanying tables of composition, very full and officially endorsed, show what variations of quality occur as we pass from the graphitic anthracites of Rhode Island and Massachusetts, across the Pennsylvania beds over the remarkable deposits of West Virginia and into the Alabamian district, or across Ohio, Indiana and Illinois, Tennesse and Kentucky deposits into the regions of the friable fuels of the Rocky Mountains and to the Pacific Coast, with its extensive distribution of lean coals and lignites.

Mr. Kent has constructed some remarkably valuable as well as novel graphic illustrations of the laws connecting composition with efficiency with varying intensities of draught and variations of air-supply, and has done much to reconcile the widely differing conclusions of investigators in this department of scientific research, who are now coming to be numerous and industrious, commensurately with a growing recognition of the importance of the subject. He has given us a larger addition to our systematized knowledge, and has added to our obligations by introducing well-established and new and useful formulas and diagrams, expressing the relations of conditions bearing upon and

determining efficiency. The discussion of 'temperature and fire' is extended and good; that of the problem of smoke prevention, the account of the automatic stoker and the full elaboration of useful algebraic formulas are points of excellence deserving of special mention. The revelation of the effect of varying air-supply with variations of the rate of combustion is new and important as here presented, and the exposition of the value of flue-gas analysis is effected in an excellent fashion.

For a first edition, this seems exceptionally free from typographical or other errors, and it may be taken for granted that later editions will follow from which even these minor defects will be completely pruned.

The book-making is good, and the maps are printed upon a fine grade of paper to insure clearness. Many of the illustrations and nearly all the diagrams are new, and the whole constitutes a work which is likely to have extensive sale among professionals and professional schools. The mathematical work and the discussions of results of boiler-tests, of which the records are presented very fully, will find constant use.

R. H. THURSTON.

A Reader in Physical Geography. By RICHARD E. DODGE. New York, Longmans Green & Co. 1900. 12mo. Pp. viii + 237. Price, 70 cents.

It is gratifying to see the new point of view in physical geography coming into our education and our literature. The application of the theory of evolution to all branches of the subject has taken it bodily from the static condition in which it was conceived by our fathers, and reestablished it as a dynamic science, live and growing. There are no longer any 'everlasting hills,' but mountains and vales wax and wane, and record the histories of their mutations in the landscape so legibly that he who runs may read. And man comes on the scene, molded inevitably by the geographic environment in which his lot is cast, and in turn reacts upon that environment in many important ways. This is the outlook Professor Dodge has in his little volume. He has written it for beginners, and his fine quality as an instructor is in evidence on almost every page. He is very happy in his ability to interpret the principles of land sculpture in the most homely similes. The beginner not only may, he must, relate the new knowledge to what is already well known to him.

The topics treated are, The Continents, The Industries of Men, The Origin of Land Forms, The Great Land Forms, Climate and other important physical features influencing man.

The book is intended as auxiliary reading for beginners in physiography, but it will also make good reading for the laity in other lines, who wish to know the way in which a physiographer looks at his problems.

J. PAUL GOODE.

Air, Water and Food. By ELLEN H. RICHARDS and ALPHEUS G. WOODMAN. New York, John Wiley & Sons. Pp. 230. Price $2.00.

The first portion of the book covers the composition and impurities of air and their relation to human life. The problem of ventilation is dwelt upon, and very proper reference is made to the faulty argument so often advanced that, because carbon dioxide is heavier than air, that therefore the proper method of securing its removal from living rooms is to provide exits for it near the floor. The public forget that the gas, as the sanitarian meets it, is warm, not cold; and that, moreover, the principle of gaseous diffusion has caused a more or less complete mixture of all the gases present in the room.

Chapter IV. gives well stated methods for air analysis.

Some eighty pages are given to the subject of water, its source, properties, relation to health and the methods employed for its examination.

Following the directions for the 'determination' of each item in water analysis, there is found a paragraph entitled 'Notes,' wherein are given in a very acceptable form the sundry hints and cautions so necessary for the guidance of the beginner. An excellent statement is found on page 81, to wit: "The value of a water analysis is in direct proportion to the knowledge and experience of the one who interprets it."

Again, on page 66, "The conclusions are not infallible, but there are enough unavoidable

risks in human life without taking unnecessary ones."

This is very true. The analyst should ever stand between the public and a questionable supply, and the consumer, rather than the water purveyor, should be given the benefit of any doubt.

The book closes with a consideration of the adulteration and examination of milk, butter, cereals and fermented liquors.

The authors have had so large and varied an experience with the subjects upon which they write, that the excellence of the present contribution to sanitary literature was to have been expected. WILLIAM P. MASON.

BOOKS RECEIVED.

Qualitative Chemical Analysis. ALBERT B. PRESCOTT and OTIS C. JOHNSON. New York, D. van Nostrand Co. 1901. Pp. xi + 420.

Tierleben der Tiefsee. OSWALD SEELIGER. Leipzig, Wilhelm, Engelmann. 1901. Pp. 49. Mk. 2.

Monographien aus der Geschichte der Chemie. Vol. VI. Pt. 2. *Christian Friedriech Schönbein*, 1799–1868. GEORGE W. A. KAHLBAUM and ED. SCHAER. Leipzig, Barth. 1901. Pp. xii + 331. $9.30.

The Induction Motor. B. A. BEHREND. New York, Electrical World and Engineer. 1901. Pp. 105.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Physical Chemistry, April. 'On an Improved Method of determining Latent Heat of Evaporation and on the Latent Heat of Evaporation of Pyridin, Acetonitril, Benzonitril,' by Louis Kahlenberg. Description of an improvement on the Berthelot apparatus for determining the latent heat of evaporation, in which the liquid is boiled by an electrically heated platinum spiral, and the results obtained by its use. 'A Class of Relations between Thermal and Dynamic Coefficients,' by George H. Burrows. 'Minumum Boiling-Points and Vapor Composition, II,' by Morris R. Ebersole. A study of acetone-benzene solution, with a classification of all mixtures of two solvents which have been studied, according to vapor-pressures and boiling points. 'On Clapeyron's Equation,' by Paul Saurel. 'Note on the Fundamental Equations of Multiple Points,' by J. E. Trevor.

IN the *American Geologist* for March, S. W. McCauley presents a discussion on the 'Trap Dykes of Georgia.' He states that they are all of the same age, and vary from an inch to two hundred feet in width and extend from a few rods to many miles. The 'Plan of the Earth and its Causes,' by J. W. Gregory, is continued from the February number, in which the writer concludes that the plan of the earth may be attributed to the unceasing shrinkage of its internal mass. Professor E. W. Claypole contributes some interesting notes on 'Petroleum in California.' 'Some Salient Features in the Geology of Arizona' is discussed by William P. Blake. This is followed by 'The Lake Systems of Southern Patagonia.' The author of this article divides the lakes into three classes—residual or salt lakes, glacial and tectonic. The April number contains a valuable contribution to the geology of 'The Piedmont Plateau of Georgia,' by Thomas L. Watson. The rocks of the region are divided into three different kinds, viz., the even-grained, massive granites, the porphyritic granites and the granite-gneisses. Of the even-grained granites, all but two possess biotite as a principal element, while hornblende is entirely wanting; the porphyritic granites are, with one exception, massive, with a composition somewhat similar to the massive granites, and in some places showing a gradation from one to the other; the granite-gneisses form extensive areas of schistose rock, similar in composition to the other two, and are believed to be metamorphosed eruptive granites. The author, after furnishing considerable proof, concludes that the region consists of eruptive granite which has been subject to the action of metamorphism and weathering, thus differentiating into the other two kinds of metamorphic rock. The age of the area is supposed to be Archæan, but it is crossed by numerous dykes of a later origin. Mr. Oscar H. Hershey contributes a paper entitled 'California Metamorphic Formations,' in which he describes the formations of the Klamath mountain region. He concludes that the schists of the upper region are somewhere between the Archæan and Devonian in age, and favors the earlier rather than the later date. This is followed by a paper, 'Fossils near Montreal,'

by Charles Schuchert, in which he describes the fauna of Saint Helena as from the Helderburg and the middle Devonic ages.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 340th meeting was held on Saturday evening, May 4th.

T. H. Kearney presented a paper on 'Loeb's Investigations into the Action of Ions upon Animal Structures, as supplemented by Studies with Seedling Plants,' quoting from Loeb's published papers at some length, special stress being laid upon their value as illustrating the theory of the rôle of ion-proteid compounds in vital phenomena. In experiments with animals it was the action of mixed solutions of two or more salts, as compared with that of each salt in a pure solution, which led to the development of this theory. The result of numerous experiments with seedling plants, as to the limit of concentration of solution which permitted the maintenance of vitality, agreed in many important points with the results obtained by Loeb in experiments with animals. In both cases salt solution was found to be highly toxic, while the addition of a second salt in many cases largely neutralized this poisonous effect and notably increased the degree of concentration of the more toxic salt in which root tips could survive during a twenty-four hours' culture.

Experiments were made with salts of magnesium (sulphate, chloride), of sodium (carbonate, sulphate, chloride and bicarbonate) and calcium chloride, all of which are important components of 'alkali' soils in the western United States. In pure solution they proved toxic in the order named, the limit of endurance for magnesium sulphate being approximately a $\frac{1}{800}$ normal solution, that of calcium chloride a $\frac{1}{4}$ normal. Mixtures were made of equal volumes of definite concentration of each two of these readily soluble salts, and of each of them with the comparatively insoluble magnesium carbonate, calcium carbonate and calcium sulphate, which are likewise abundant in the alkali soils.

In several cases addition of a sodium to a magnesium salt considerably raised the limit of concentration of the latter endurable by the roots of the white lupine (*Lupinus albus*), but the most striking results were obtained by the addition of calcium, either as chloride or sulphate, to magnesium and sodium salt solutions. Calcium sulphate, added in simple excess of the powdered salt, proved extraordinarily efficacious in neutralizing the toxic effects of other bases, increasing the maximum endurable concentration for sodium sulphate from $\frac{3}{400}$ to $\frac{1}{2}$ normal, and for magnesium sulphate from $\frac{1}{800}$ to $\frac{3}{5}$ normal.

In a $\frac{2}{3}$ or $\frac{3}{5}$ pure solution of magnesium sulphate the root cells were strongly plasmolyzed, while in a corresponding solution plus an excess of calcium sulphate no trace of the plasmolyzing action could be detected. The effect of calcium sulphate upon the corresponding chlorides was much less marked. Hence, while in some cases the effects of mixtures could be ascribed to the kations (basic radicle) alone, in others it seems clear that the anions are also able to make their influence felt. Hydroxyl ions, dissociated in very dilute solutions of sodium carbonate (Na_2CO_3), and sodium bicarbonate ($NaHCO_3$), markedly stimulated the growth of the roots, just as Loeb found them to stimulate the gastrocnemius of frogs, to absorption of water from, and rhythmical contraction in, a sodium-chloride solution.

The results of this investigation, which was undertaken at the request of the Chief of the Bureau of Soils of the Department of Agriculture, are to be described in a forthcoming bulletin of the Division of Vegetable Pathology of that Department. They are believed to have considerable economic significance, apart from their bearing upon the question of the influence of ions upon organisms.

Under the title 'A Kinetic Theory of Evolution,' Mr. O. F. Cook suggested, on the basis of studies in the Diplopoda and other groups, that evolution be interpreted as a kinetic phenomenon or process of gradual and spontaneous accumulation of variation instead of a reaction to external conditions. It was also held that the differentiation of species is a process quite distinct from evolutionary progress, and that selection and isolation may conduce to the

former while retarding the latter. In this view evolution would be favored by interbreeding rather than by segregation, and natural selection would be an incident rather than a cause of evolution. Diversity was shown not to be conditioned upon segregation, but to be distinctly favored in the economy of species. Under a kinetic theory the origination and inheritance of characters represent but different statements of the same facts, and the predication of a 'hereditary mechanism' is unnecessary. Evolution is not confined or directly connected with any one type of cells or method of reproduction, but is a general property of protoplasm; it is not only a cellular or cytological, but a supracellular or organic, process; evolutionary theories must accommodate both unicellular and compound individuals, and even treat as evolutionary units the colonies of the social insects.

F. A. Lucas.

CHEMICAL SOCIETY OF WASHINGTON.

An adjourned meeting was held in Hopkins Hall, Johns Hopkins University, Baltimore, Md., on April 27th, when the following program was presented: 'The Lowering of the Freezing Point of Aqueous Hydrogen Dioxide,' by H. C. Jones. The author stated that an attempt was made to measure the dissociating power of hydrogen dioxide by means of the conductivity method. This method was abandoned, since all the metals used as electrodes decomposed the dioxides, even at zero degrees. The lowering of the freezing point of aqueous hydrogen dioxide by certain salts was measured and was found to be less than the lowering of the freezing point of water, under the same conditions.

'The Preparation of Semi-Permeable Membranes for the Demonstration of Osmotic Pressure,' by Professor H. N. Morse. The author referred to the difficulties encountered in the preparation of osmotic cells by the method of Pfeffer, and stated the results of some preliminary experiments, undertaken in cooperation with Dr. D. W. Horn, in attempting to overcome these difficulties. Instead of expelling the air from the walls of the cups by immersion in water and exhaustion with an air-pump, as is done in the method of Pfeffer, electrical endosmose was employed, the cup being immersed nearly to the top and filled with a dilute solution of potassium sulphate, then surrounded by a cylindrical electrode and another one placed inside. A one-ampere current was passed through the solution for 15 minutes, from the outer to the inner electrode, causing a rapid passage of liquid through the walls of the cup and freeing them from air. The cup was then removed, emptied, rinsed and placed in water until used for the formation of membrane. The method described by the author was as follows: A cup whose walls had been freed from air and filled with water was placed in a solution of a copper salt and filled with a solution of ferrocyanide. A current was passed from the outside inward, the copper and ferrocyanogen ions being driven into the walls from opposite directions; a membrane was built up wherever they met. The results were very satisfactory. The method of construction of the electrodes was described and the resistance of the cups stated. On breaking the cup, the membrane was found as a reddish brown line, usually in the middle of the wall, though deviating more or less to one side or the other.

'Molecular Rearrangement of Sulphamine Acids,' by Dr. Ira Remsen.

'On a Reduction Process for Tin at Comparative Low Temperatures, and Recovery from Waste Products,' by Chas. Glaser. This paper gave a description of a process invented by John C. Toliaferro for the recovery of tin from waste products. The refuse from tin-plate works consists of the remnants of the fatty acids used to protect the black plates from reoxidation after cleaning with acid, and more or less oxidized tin, which often contains some free metal or mixed oxides of tin and lead. The refuse from the oils often contains oxides of the two metals, which are usually recovered by burning off the oil and collecting the residue and metallic fumes. The united dross is reduced to metal in a suitable furnace. Mr. Toliaferro observed that under certain conditions he obtained metallic tin from the refuse fatty acids by heating them to incipient decomposition. Certain experiments were made showing that at a temperature a little above the melting point of tin, stannous soaps are reduced to metallic tin,

gaseous products and some carbon. From these observations the following reduction process was evolved: A large iron pot is heated from below, so that a piece of tin dropped at the bottom will melt. The pot is then filled with refuse fatty acids and the heat increased until they commence to give off vapors. Stannic dross is then introduced with stirring. This may be continued at pleasure or until the fatty acid is almost used up. The reduced tin is removed at convenient intervals.

'On Dr. Theodore Meyer's Tangent System of Sulphuric Acid Chambers,' by Chas. Glaser. The author described a modification of the construction and working of lead chambers used in the manufacture of sulphuric acid. The modification relates to the shape of the chambers and the motion of the gases. Ordinarily the chambers are square and the gases introduced in such a way that they traverse the chambers but once, get only moderate mixing, except where they fall upon the chamber curtains and where they are forced through relatively narrow connecting pipes between chambers. In the modification described, the chambers are round or polygonal, the gases are introduced near the ceiling in the direction of a tangent, and are removed through the center of the bottom by suitably constructed pipes. Experiments show that the gases move first along the sides of the chamber, drifting towards the center in such a way that the whole content gets into rotation. Cooling and draught bring the whirlpool in the center to the exit pipe. When introduced into the second chamber, the gases retain the revolving motion derived from the first, to which is added the motion of the second, so that an epicycloid motion is produced. The gases traverse the chambers a good many times, increasing largely the amount of work performed. It has been demonstrated that by this method the necessary chamber space for one pound of sulphur in twenty-four hours is reduced to below ten cubic feet as against twenty in the old system. The author stated that the cost of producing sulphuric acid, so far as labor and lead chambers are concerned, is reduced to fifty per cent. of what it was by the old method.

'The Solubility of Gypsum in Aqueous Solution of certain Electrolytes,' by Frank K. Cameron and Atherton Seidell.

This paper gave a description of the complete solubility curves for gypsum in aqueous solutions of sodium chloride, magnesium chloride, calcium chloride, sodium sulphate and a mixture of sodium chloride and calcium hydrogen carbonate at 25° C. With sodium chloride and magnesium chloride the curves show maximum points. The formation of complex ions the authors believe to be possible and probable, but the deviations from the *mass law* are more likely to be due to a condensation of the solvent itself.

With sodium sulphate it was shown that the solubility of the gypsum first decreased and then increased, with increasing concentration of the more soluble salt, until it became greater than in pure water. It is believed that a double salt was formed in the solutions, possibly identical with the mineral glauberite. It did not separate from the solutions on evaporation, however, at ordinary temperatures. Here again the authors think the condensation of the solvent probably plays an important rôle and, under such circumstances, it is probable that the sodium sulphate dissociates to a large extent or completely as a di-ionic electrolyte. The composition of the solid phase, containing both calcium sulphate and sodium sulphate, did not apparently affect the composition of the solution in contact with it. This is regarded as of sufficient interest to merit further investigation. In solutions of calcium chloride the solubility of the gypsum decreases quite rapidly at first, and then very slowly but steadily as the concentration of the more soluble salt increases.

When calcium carbonate in the solid phase was also in contact with solutions of sodium chloride, and was brought to equilibrium with ordinary air, it was found that up to concentrations of about 80 grams per liter of sodium chloride, the gypsum dissolved in very nearly the same quantities as though the calcium carbonate were not present. From this point on, however, the curve makes a sudden drop and then the solubility of the gypsum slowly decreases.

Applications of the results to geological and technical studies were indicated, and a theoreti-

cal discussion accompanied the description of the experiments.

'The Solubility of Calcium Carbonate in Aqueous Solutions of certain Electrolytes and in Equilibrium with Air,' by Frank K. Cameron and Atherton Seidell:

Since the solubility of the calcium carbonate is dependent upon the amount of carbon dioxide in the gas phase in contact with the solution, the solutions were brought to equilibrium with air, previously washed in dilute sulphuric acid, and bubbled through the solutions by means of an aspirator. It was found that the curve for sodium chloride presented a well-marked maximum point. No normal carbonates were in the solution, the calcium dissolving entirely as the hydrogen carbon.

In sodium sulphate solutions, the major part of the calcium dissolved as the hydrogen carbonate, though at the higher concentrations normal carbonates were also found. The curve for this pair of electrolytes showed no maximum point. Curiously, it was found that calcium carbonate was much more soluble in solutions of sodium sulphate than in solutions of sodium chloride, at all concentrations.

The presence of solid gypsum was found to produce an effect on the solubility of calcium carbonate in sodium chloride solutions, greater in amount but similar in nature to that produced by calcium carbonate on the solubility of the gypsum in sodium chloride solutions, and described in the preceding paper. Practical applications of the work were pointed out and a theoretical discussion of the results obtained was given.

L. S. Munson,
Secretary.

TORREY BOTANICAL CLUB.

At the meeting of the Club on March 27, 1901, the first paper of the evening was by Dr. John K. Small on 'The North American Genera of Mimosaceæ.' Dr. Small exhibited a uniform series of diagrammatic drawings, illustrating the flowers and fruit of each of these genera, and explained his proposed classification, replacing the previous artificial grouping. The variability of the fruit in valves, margins and cross-partitions was commented on. Discussion of the common sensitive-plant followed, in which it was remarked that the sensitiveness to shock is so delicate as to be stimulated by holding a burning-glass near, or by drops of rain-water on first falling, or by holding a sponge of ammonia or of chloroform near. The utility seems unknown, except as the hot sun setting the leaves on edge prevents injury from intense sunlight. Sachs's suggestion was that the depression of the leaves served as a protection from hail; but it now appears that the native center of the plant is chiefly in the Orinoco regions where hailstorms are unknown. Much energy is exhausted by folding, and it is well known that the greenhouse sensitive-plants are frequently worked to death by repeated irritation.

The second paper, by Dr. Rydberg, soon to be printed, was on 'The Oaks of the Rocky Mountains,' in which region eleven species were described in Sargent's 'Silva,' a number now increased by Dr. Rydberg to twenty-eight.

E. S. Burgess,
Secretary.

THE ONONDAGA ACADEMY OF SCIENCE.

The 47th regular meeting was held in the Historical rooms, Friday P. M., May 17, 1901.

The first paper was by Dr. John Van Duyn, entitled, 'The Terrestrial Life of Porto Rico.' Dr. Van Duyn spoke entertainly concerning many facts and observations made during his recent visit, as the deep blue of the ocean, the appearance of different constellations, the character of the rocks and their probable formation, the differences in wind and climate of the northern and southern shores of the island, the animal and plant forms, and the inhabitants. The latter are a mixture of Spaniard, negro and native Indian. Although it has been maintained by high authority that the Indian types have been entirely lost, Dr. Van Duyn was positive that this was not so. He believes that the race possesses vast capabilities for development.

A second paper, entitled 'The Marine Life of Porto Rico,' was given by Dr. C. W. Hargitt, of Syracuse University. He briefly narrated the early work in the natural history of Porto Rico and then told of the recent expedition of the *Fish Hawk* to those waters, and of the

material thus collected. The fishes have already been described in the Report of the U. S. Fish Commission just published; and of the other forms which were sent to the various universities for examination and study, Dr. Hargitt reported on the material received here. The collection comprises the 'Alcyonaria,' and among the forms were several genera new to American waters, and six species new to science. The descriptions of all these will be published in the Reports of the Fish Commission during the present summer.

PHILIP F. SCHNEIDER.

DISCUSSION AND CORRESPONDENCE.

THE LARYNX AS AN INSTRUMENT OF MUSIC.

IN the *American Journal of Science* for April, 1901, Vol. XI., p. 302, an account was given of some speech curves that confirm the view that vowels are usually produced by intermittent puffs of air and not by vibrations of the form generally supposed. The following conclusions were reached: (1) The movement of the air in the mouth cavity is a free vibration and not a forced one; (2) the impulses from the larynx in making vowels are of the nature of explosive openings or sharp puffs of air. It was shown that the characteristic mouth tones in vowels are generally inharmonic to the larynx tone. The elaborate vowel tracings of Professor Hermann (Königsberg) and the late ones of Dr. Pipping (Helsingfors) had already proved that in song the mouth does not reinforce an overtone of the cord; my curves showed the same condition for ordinary speech. Similar results have been obtained by Boeke (Alkmaar), Bevier (New Brunswick), Donders (Utrecht), Merritt (Cornell), Samojloff (Moscow), and others, and can be seen in plates published by Nichols and Merritt (Cornell). The proof is on all sides complete and incontestible that Willis's theory ('Camb. Philos. Trans.,' 1830) of vowel formation is the correct one and that the theory of Wheatstone ('Lond. and Westm. Rev.,' 1837) is erroneous. Although the adoption of the Wheatstone theory led to numerous investigations and secondary hypotheses by Grassmann, Helmholtz and others, its phonetic difficulties were never overcome.

It was also pointed out that the structure of the larynx practically forbids any consideration of the vocal bands as membranous reeds. The accompanying figure is an outline section of the

vocal muscles (*aa*) whose vibrations produce the tone in song and speech. They bear no resemblance in structure or action to membranous reeds. When they are brought together by the action of the arytenoid cartilages, they close the passage of the larynx until forced apart by the air pressure. When this occurs a puff of air is emitted and they close again. The sharpness or smoothness of the puff is regulated by the contraction of the various portions of the thyro-arytenoid muscles which compose the vocal bands. The puffs in their physical forms resemble those that can be produced by a siren disk with differently shaped openings (Seebeck).

Structures of the nature of the vocal bands yield to the air pressure and vibrate wholly or mainly by a side movement, and not by the flap or lateral movement of membranous reeds. Professor Ewald (Strassburg) has illustrated their action by constructing cushion pipes. That the vibratory movement affects the bands through most of their depth is shown by the nodal lines seen with the laryngo-stroboscope of Oertel (Munich). Helmholtz's statement: "Im Kehlkoffe spielen die elastischen Stimmbänder die Rolle membranöser Zungen. Sie sind von vorn nach hinten gespannt, ähnlich den Kautschukbändern * * *," was based on the anatomical and physiological knowledge of the time at which he wrote the first edition of the 'Tonempfindungen.'

Professor Le Conte (California) in SCIENCE for May 17, N. S., Vol. XIII., p. 790, points out that he had already said that the larynx 'cannot be likened to a stringed instrument nor

to a reed-pipe,' and suggests the resemblance between the vocal band action and the lip action in blowing a horn. Whether the lips in blowing a horn vibrate laterally as reeds or by compression as cushions, I am unable to say; they may quite possibly vibrate in a manner different from that assumed by Helmholtz.*

E. W. Scripture.

Yale University,
New Haven, Conn.

PHYSIOLOGY IN THE SCHOOLS.

To the Editor of Science: Judging from the letter of S. W. Williston in your issue of May 24th, people must acquire their mental growth much more rapidly in Kansas than they do in the East. If I were confronted in an examination for the degree of doctor of philosophy with the question 'Why does the human body cease to grow about the twenty-fifth year?' I should think there were strong grounds for suspecting the examiner of endeavoring to show what I did not know, even at the price of asking questions whose answers I could not know. Yet we are told that this question has been asked of candidates for the State teacher's certificate. The theory of accelerated mental development is furthermore strongly supported by the apparent fact that children are expected, by the time they finish with the grammar school, to know about pleurisy, the respiratory center, residual air, appendicitis, *meatus auditorius* and the *motores oculi*.

If mental development is anywhere as rapid as these facts would suggest, there can, of course, be no criticism with regard to the consideration of these questions in physiology at the time indicated.

If, however, children generally show about the same rate of mental development as I have observed in the East, the writer would like to suggest that if less time were consumed in the contemplation of useless details of anatomy, relieved by worse than useless rambles into pathology, and more in the plain, common sense, practical study of the conditions of healthy living, teachers would no longer learn in examination papers that 'the body should be bathed frequently, should be bathed at least once a year.' There is, in fact, a horrible suspicion in the mind of the writer that something else than the text-book is at fault.

Theodore Hough.

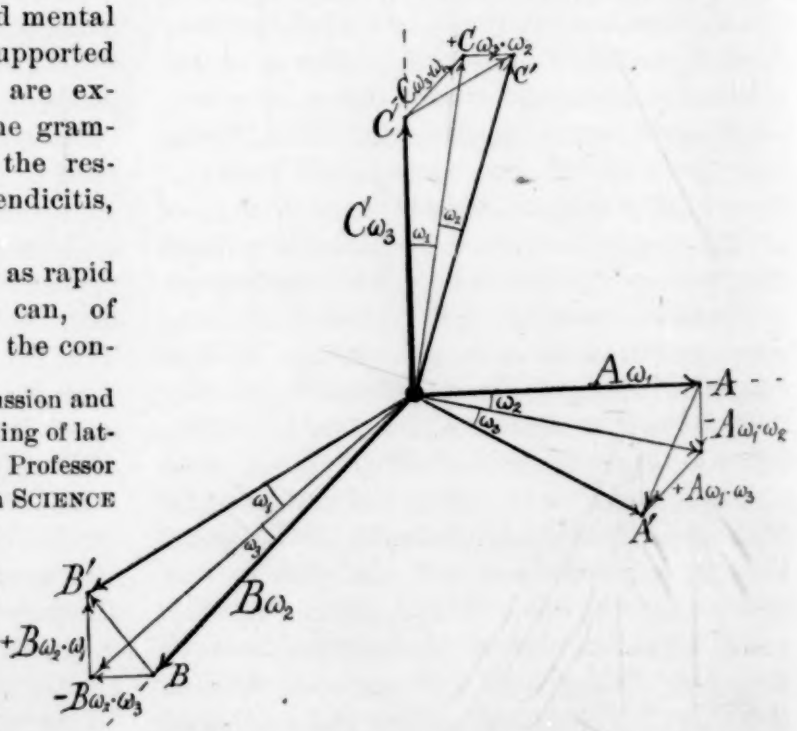
Massachusetts Institute of Technology,
May 25, 1901.

* Misunderstanding the point under discussion and supposing that Professor Le Conte was speaking of lateral vibrations of the lips and vocal cords, Professor Webster (Clark Univ.), replies to him in Science for May 24, N. S., Vol. XIII., p. 827, that the action of the lips and the vocal cords had already been explained by Helmholtz and that his description of 1862 'has never needed any improvement or correction.' Professor Webster asserts that he regards the simple *model* of a membranous reed pipe with a sheet of rubber in lateral vibration as 'a very convincing demonstration of the mode of action of the larynx.' He also classifies elastic cushions as 'reeds.'

SHORTER ARTICLES.

THE GENERAL EQUATIONS OF ROTATION OF A RIGID BODY.

After writing my brief note on the top,* it occurred to me that the same method might be used to derive the Eulerian equations of rotation briefly and at once, in a way almost pic-



* This Journal, May 31, 1901.

torially lucid as to the meaning of the terms involved.

Let A, B, C, be the principal axes of inertia and ω_1, ω_2, ω_3, the angular velocities of the rigid body around them. All this is kinematic.

Let A', B', C', be the positions of these axes a unit of time later. Lay off the angular momenta, $A\omega_1$, $B\omega_2$, $C\omega_3$, along these axes in order, as shown. Then will AA', BB', CC', be the corresponding per second changes of angular momentum.

Resolve each of these into components parallel to the original axes, and bring those belonging to the same axis together, viz.,

$$\begin{array}{lll} -B\omega_2\cdot\omega_3, & -C\omega_3\cdot\omega_1, & -A\omega_1\cdot\omega_2, \\ +C\omega_3\cdot\omega_2, & +A\omega_1\cdot\omega_3, & +B\omega_2\cdot\omega_1, \end{array}$$

remembering that as each axis rotates about the other two, the component displacements per second will be

$$\omega_2,\ \omega_3;\ \omega_3,\ \omega_1;\ \omega_1,\ \omega_2.$$

Add to the component changes of momentum found, the direct per second changes of angular momentum around the respective axes, viz.,

$$+A\dot{\omega}_1, \qquad +B\dot{\omega}_2, \qquad +C\dot{\omega}_3.$$

Let L, M, N, be the torques around the three axes in order, and equate these to the *total* per second change of angular momentum corresponding to the same axes. In other words, after adding each of the three columns,

$$\begin{aligned} L &= A\dot{\omega}_1 - (B-C)\omega_2\omega_3, \\ M &= B\dot{\omega}_2 - (C-A)\omega_3\omega_1, \\ N &= C\dot{\omega}_3 - (A-B)\omega_1\omega_2. \end{aligned}$$

C. BARUS.

ON A CRINOIDAL HORIZON IN THE UPPER CARBONIFEROUS.

FOR more than half a century the Lower Carboniferous limestones of the Mississippi valley have been justly celebrated for their enormous wealth of crinoidal remains. On this account, they have become widely designated as Encrinital limestones, a title which has long since assumed a distinctive value.

The crinoidal element in the faunas of the Lower Carboniferous has been further emphasized by the apparent extreme paucity or entire absence of crinoid remains in all other parts of the Carboniferous section of the region. The few species described were few in number, from widely separated localities and from very fragmentary material.

Unusual interest was, therefore, aroused a few years ago by the discovery, in the Upper Carboniferous rocks of the Missouri river, of a formation so rich in fossil crinoids as to merit the title Encrinital as appropriately as any terrane of the Lower Carboniferous. Species were not only new and numerous, but individuals occurred in the utmost profusion, their stems and long, slender, beautifully pinnulated arms intertwining as intricately as the richest of flowing arabesques. Moreover, the state of preservation was wondrously perfect. From a morphological standpoint the discovery was one of the most important ever made.

The geological position of this rich crinoid fauna is a short distance above what is called the Lower Coal Measures. It is in the terrane now known as the Thayer shales, the base of which is a stratigraphic level not much over 600 feet above the Lower Carboniferous limestones. The Thayer shales are in the lower part of the Missourian series. They are dark blue in color, and lithologically are indistinguishable from the Crawfordsville Shales of Indiana, which have been so prolific in crinoids in fine state of preservation.

The biological peculiarities of the crinoids from the Thayer shales as compared with those of the nearest forms from the Lower Carboniferous are noteworthy features. For two faunas so closely connected in space the differences are so profound when apposed to the resemblances as to be almost inexplicable.

But a satisfactory solution of the remarkable problem has been lately supplied from a source other than the biotic. The recently worked-out stratigraphy of the region throws light upon it in an unsuspected manner. The actual position of the Thayer shales, instead of being re moved only 600 feet from the Lower Carboniferous limestones, are, stratigraphically, thousands of feet away.

While the lower coal measures have long been known to rest unconformably upon the underlying rocks, the stratigraphic break has been regarded as merely local in nature. Of late, the real significance of this hiatus has been

adjudged. A depositional equivalent has been found in a neighboring State. In central Arkansas, the unconformity is now discovered to be represented by no less than 20,000 feet of sediments. The real values of the new relationships of the horizons are better shown by a rectified general geological section of the Carboniferous of the region.

WESTERN INTERIOR SECTION.

Series.	Terrane.	Thickness.
Oklahoman.	Not here differentiated.	1,500
Missourian.	Cottonwood limestone.	10
	Atchison shales.	500
	Forbes limestones.	25
	Platte shales.	105
	Plattsmouth limestones.	30
	Lawrence shales.	265
	Stanton limestones.	35
	Parkville shales.	75
	Iola limestone.	30
	Thayer shales.	50
	Bethany limestones.	75
Des Moines.	Marais des Cygnes shales.	250
	Henrietta limestones.	50
	Cherokee shales.	200
Arkansan.	Not here differentiated.	20,000
Mississippian.	Not here differentiated.	1,500

Of these five series of the Carboniferous system, the Oklahoman represents the so-called Permian; the next three the coal measures; and the Mississippian the Lower Carboniferous. Measured in sediments, the horizon of the Thayer crinoids is far up in the Carboniferous, instead of being near the base. At Kansas City, where the crinoids were found, the Arkansan is represented by the hiatus—a period of vast erosion in that locality.

Charles R. Keyes.

THE PROCESS OF FREEZING IN PLANTS.

In text-books on plant physiology, and in original articles upon the effects of freezing in plants, or on allied subjects, so far as is known to the writer, there is no working explanation of the process. The matter is referred to by Detmer and Moor, Vines, Haberlandt, Sorauer, Sachs and many others, but without detailed explanation.

The cells bounding the intercellular spaces (in leaves) are always moist on the side in contact with the air. As cooling goes on, all the tissue, contents of the cells and all, are contracting; but when a temperature of about 4° C. is reached, the water content of the cell begins to expand, while the wall goes on contracting. This forces more moisture into the intercellular spaces. When the freezing point for water is reached, ice crystals begin to form outside of the cell in the intercellular spaces. The ice crystals will form first here, because water has a higher freezing point than the solution within the cell. As cooling goes on, and further crystallization takes place, the freezing water gives off its latent heat which tends to keep, for a considerable time, the cell contents from freezing. The crystallizing water without the cell extracts water from the cell by an inherent attractive force which the molecules of the mother crystal have for its liquid. This force is the cause of further water being drawn from the cell to build up the crystal of ice, and this attractive force is a similar one to that which causes plasmolysis in the case of the common experiment with cells of *Spirogyra* and a solution of sodium chloride. The ice forms first in the intercellular spaces and continues to form there until the cell contents become frozen.

If a leaf so frozen be subjected to a higher temperature, water will be formed in the intercellular spaces, resulting in a translucent, 'water-logged' appearance of the tissue of the leaf. If, however, the temperature be raised very gradually, the cells will probably resorb the extracted water as rapidly as it is formed, resulting in no permanent injury to the leaf. Sachs found that the leaves of the beet and the cabbage frozen at from — 4° C. to — 6° C., and thawed in air at 2 to 3° C., were killed, while when thawed slowly in water at 0° C. they survived.

If the temperature be low enough and be continued long enough a permanent injury would result, for then the cell-contents would become solidified.

In the case of the experiment with a beet partially scooped out and subjected to a freezing temperature, the formation of ice in the cavity is brought about in exactly the same way as it is in the intercellular spaces in leaves of plants, excepting on a larger scale. If the

freezing of the beet be brought about slowly, water may be drawn into the cavity from a considerable distance from cell to cell within the tissue.

Certain strong non-poisonous solutions, when applied to the cut ends of the petioles of leaves, produce a similar translucent effect in the tissue of the blades of leaves, as is shown by the writer in a paper now in process of publication.

JAMES B. DANDENO.

BOTANICAL MUSEUM OF HARVARD UNIVERSITY, May 22, 1901.

THE AMERICAN MATHEMATICAL SOCIETY.

A PRELIMINARY circular, which has just appeared, describes the arrangements which have been made for the summer session of the American Mathematical Society to be held at Cornell University, Ithaca, N. Y., during the week beginning on August 19th. The meeting proper, for the transaction of business and the presentation of papers, will take place on the first two days, while the remainder of the week will be occupied by a colloquium. Two courses of lectures by Professor Oskar Bolza, of the University of Chicago, and Professor E. W. Brown, of Haverford College, are announced as the basis for this colloquium, which will be the third organized by the society in connection with its summer meetings. Professor Bolza's subject is 'The calculus of variations, in particular Weierstrass's discoveries.' The principal object of the course is to give a detailed account of the solution of the simplest type of problems, in its historical development, with special emphasis upon the contributions of Weierstrass and his followers. A summary review of the peculiar features of the more general problems is also intended. Professor Brown will lecture on 'Modern methods of treating dynamical problems and in particular the problem of three bodies.' The object of this course is to set forth some of the later attempts to introduce more rigor into the methods of solving dynamical problems, mainly the researches of Poincaré. The course will be chiefly descriptive, in showing the principles of the methods, the mathematical difficulties which arise, and the results which have been obtained. Among the subjects treated will be the following: the various forms of the differential equations of dynamics, the existence of integrals, solutions by infinite series, periodic solutions, stability and instability. In neither course will special knowledge of the subject be presupposed.

SCIENTIFIC NOTES AND NEWS.

DR. IRA REMSEN, professor of chemistry in the Johns Hopkins University since its foundation in 1876, has been elected president of the University.

A COMMITTEE, consisting of Professors Ira Remsen, J. S. Ames and W. H. Welch, has been appointed at the Johns Hopkins University to arrange a memorial to the late Professor Henry A. Rowland.

M. LAVERAN, the French army surgeon who discovered the malaria parasite, has been elected a member of the Paris Academy of Sciences in the section of medicine, filling the vacancy caused by the death of M. Potain. In the third ballot M. Laveran received forty, and M. Ch. Richet twenty-six, votes.

AT a recent meeting of the National Geographic Society, the by-laws were so changed as to merge into the single class of 'members' the two classes hitherto designated 'resident members' and 'non resident members,' and also to increase the board of managers from 18 to 24, including six not resident in the District of Columbia. The board has now been completed by the election of the following non-resident members: Professor William M. Davis, Cambridge; Mr. Russell Hinman, New York; Professor Angelo Heilprin, Philadelphia; Dr. Daniel C. Gilman, Baltimore; Professor Rollin D. Salisbury, Chicago, and Professor George Davidson, San Francisco.

DR. G. A. HANSEN, of Bergen, the discoverer of the bacillus of leprosy, will celebrate his sixtieth birthday in July, and it is proposed to present him with an international testimonial made up of small subscriptions. These may be sent to Dr. Sandberg, Bergen.

PROFESSOR EDWARD F. MORLEY, of Adelbert College, has been appointed a delegate from the United States to the International Conference of Weights and Measures, which is to be held in Paris during September.

Dr. Warren P. Lombard, professor of physiology in the University of Michigan, will spend the summer abroad and will attend the International Physiological Congress to be held in Turin in September.

Dr. Franz Boas, professor of anthropology in Columbia University and curator of ethnology in the American Museum of Natural History, has been appointed philologist in the Bureau of American Ethnology. The appointment is an honorary one, and Dr. Boas will direct the work from New York City.

Professor William James offers a course next year at Harvard University on 'The Psychological Elements of Religious Life,' based on the Gifford lectures now being given at Edinburgh.

Dr. T. C. Hopkins, professor of geology at Syracuse University, will work on the geological survey of Indiana during the summer vacation. An attempt will be made to complete the work for a new edition of the geological map of Indiana.

The Carnegie Museum has despatched Mr. W. E. C. Todd, custodian of the collections in ornithology, Dr. D. A. Atkinson and Mr. George Mellor to the Maritime Provinces and Newfoundland to make natural history collections for the museum during the coming summer. Professor J. B. Hatcher is engaged in taking up fossils at Cañon City, Colorado, Mr. O. A. Peterson is continuing the work begun by Professor Hatcher in western Nebraska last year, and the quarry at Camp Carnegie, on Sheep Creek, Wyoming will be worked during the coming summer by a party under Mr. C. W. Gilmore.

Professor C. L. Bristol, of New York University, left New York on June 1 to direct the Biological Station at Bermuda.

The house-boat *Megalops* of the Zoological Survey of Minnesota, under the direction of Professor Nachtrieb, has been hauled ashore near the head of Lake Pepin, a few miles below Red Wing, where it will be used as station headquarters. A gasoline launch has been purchased for this station, and, in line with the plan begun with the rowboat *Zosa*, has been called *Callinectes*. There is also to be constructed a boat specially adapted for dredging and similar work. This boat will be called *Branchippus*. Professor Nachtrieb will send a party of four into the Lake Vermillion region and the N.E. corner of Minnesota. A party of two will conduct special investigations in the Lake of the Woods, and another will carry on work at the Lake Pepin station.

Sir Courtenay Boyle, permanent secretary of the Board of Trade, died in London on May 19. Sir Courtenay had in various official positions contributed much to the applications of science especially as supervised by the government.

Mr. E. W. Parsoné died in London on May 20. He was interested in submarine telegraphy and had done scientific work in connection with the transit of Venus and in other directions.

Mr. Anthony Wilkin died at Cairo on May 17. Although only twenty-four years of age, he had accomplished good work in several scientific expeditions. He was a member of the Cambridge anthropological expedition to Torres Straits, and had carried on archeological work in Egypt with Professor Flinders Petrie.

It is announced that Mr. John D. Rockefeller has given $200,000 for the foundation of an institute for medical research, and it is understood that this fund will be increased as needed. We lack in America an institution corresponding to the Pasteur Institute in Paris or the institution in London recently endowed by Lord Iveagh. It appears that this need will be met by Mr. Rockefeller's gift, though the exact scope of the institution is still under consideration.

It is said that Mr. Alfred Harmsworth has subscribed $50,000 toward an institute in London for the cure of lupus by exposure to light.

The U. S. Civil Service Commission announces that owing to lack of applicants the examination, announced to be held on June 3, for the position of secretary of the National Bureau of Standards, Treasury Department, has been postponed to June 22, and will be held in any city in the United States where postal free delivery has been established. The duties of this position are those of general sec-

retary to a scientific or technical bureau and include the handling of the general correspondence of the Bureau and the editing of bulletins and reports. The occupant of this position will also act as purchasing agent and have charge of the official records, apparatus and equipment, and will be executive officer of the Bureau. The examination will consist of the subjects mentioned below which will be weighted as follows:

1. Stenography and typewriting	20
2. Editing and proofreading (practical tests)	10
3. Education and training	20
4. General experience in editorial and executive or business capacities	50

The test in typewriting will comprise practical work in tabulating and copying and spacing. Some knowledge of stenography will be required. Applicants for this position should possess a knowledge of elementary physics, chemistry and mathematics, such as prescribed in the general science course of any college or technical school. No person will be examined who has not had a liberal college education or its equivalent. From the eligibles resulting from this examination it is expected that certification will be made to the position of secretary of the National Bureau of Standards, Treasury Department, at a salary of $2,000 per annum.

A CIVIL service examination will be held on July 2d and 3d to fill the position of photographer in the Division of Forestry, U. S. Department of Agriculture, with a salary of $1,200. The examination is on photographic methods, and does not require a knowledge of botany or of forestry.

THE American Academy of Medicine and the American Medical Association are meeting at St. Paul during the present week.

THE American Forestry Association will hold its meeting in affiliation with the American Association at Denver on August 27, 28 and 29.

THE Royal Geographical Society held its anniversary meeting on May 20. Sir Clements Markham, the president, in his address, laid special stress on the British Antarctic Expedition. He said that toward sending a special ship in November, 1902, the sum of £5,500 had been subscribed toward the £15,000 required. The medals were conferred in accordance with the announcements we have already made, Dr. A. Donaldson Smith being present to receive the patron's medal. It was announced that the total number of fellows is 3,997, and the income last year was over £10,000.

THE British Institution of Mechanical Engineers held its annual conversazione on May 17. The annual meeting of the institution will be held at Barrow in Furness during the last week in July.

Owing to an accident connected with the apparatus for adjusting the propeller, the steamship *Discovery*, of the British National Antarctic Expedition has been unable to leave Dundee for London at the time expected.

PROFESSOR H. H. GIGLIOLI, of the Royal Zoological Museum, Florence, writes to *Nature* that on April 13th the second annual meeting of the Zoological Union of Italy concluded its work at Naples. This Union was formed at Pavia last year and in the following September it held its first general meeting at Bologna, which proved to be quite a success as to the work performed and the large attendance. It became evident that the Union, the scope of which is to collect the scattered forces of students of zoology and to prepare the way for the foundation of a zoological journal worthy of Italian science, has responded to a wish generally felt in Italy. The Union now counts amongst its members nearly all the Italian professors of zoology and anatomy and many other students of those sciences. The meeting at Naples was even more numerous than that at Bologna, and many interesting communications were read. Bologna greeted the assembled zoologists with the memories of its old masters—Aldrovandi, Malpighi, Alessandrina and others; at Naples they were *fêted* by that great center of zoological investigations, the Zoological Station, whose steam-launch, which bears the glorious name of *Johannes Müller*, gave the visitors practical examples of pelagic trawling and dredging, as the war steamer *Ercole* bore them to Capri. Rome has been chosen for the third Congress, in 1902, 'when,' remarks Professor Giglioli, 'we shall be proud

and happy to welcome any of our foreign colleagues who should choose to honor us with their presence.'

UNIVERSITY AND EDUCATIONAL NEWS.

HAMLINE UNIVERSITY, at St. Paul, Minn., has received a fund of $100,000 of which $50,000 is from Mr. James J. Hill and $30,000 from Mr. M. G. Norton.

AN Edinburgh correspondent telegraphs to the London *Times* that the details of the scheme already announced of Mr. Andrew Carnegie's great benefaction to his native land appear to have been only partial, and much misconception has been created and adverse criticism made owing to the absence of the full facts. It appears that an understanding was come to by those to whom Mr. Carnegie has already sketched an outline of his scheme that no communication should be made regarding it until the matter had assumed definite shape. This understanding has been violated, and the unfortunate result is that a very misleading, because partial, account of the scope of Mr. Carnegie's munificent gift has been published. Mr. Carnegie has in view a much wider scheme of benefiting Scottish education than that of making education free to Scottish university students. In a few days Scotland will be in possession of the full facts. In the meantime the outline published has given much needless alarm as regards the extra-mural schools. The scheme will amply provide for extra-mural schools, and every boy and every girl who enters a Board school will, if the ability be shown, rise to the highest seat of learning without the payment of a single farthing in fees. Not only will the amplest provision be found to be made to open the gates of knowledge, but also to raise the universities of Scotland to the foremost rank.

IT will be remembered that Yale University has recently abolished required studies in the Sophomore year, and that students may now choose either five or six of twelve subjects that are offered. The elections for next year are as follows: English, 258; history, 216; physics, 194; chemistry, 194; German, 162; French, 155; Latin, 131; mathematics, 112; Greek, 110; mental science, 45; philosophy, 7; analytical geometry, 6.

AT the recent commencement of the Medical Department of the Western University of Pennsylvania, seventy-five diplomas were granted to men who had completed the course of four years in medicine which is required. The Medical Department is engaged in a struggle to resist the encroachment of purely political influence in the appointment of the surgeons and physicians on the staff of the Western Pennsylvania hospital with which the college stands related. The contest is awakening general interest throughout the State.

THE Japanese university for women in the suburbs of Tokio was opened with appropriate ceremonies on April 21.

THE council of the University of Birmingham is prepared to appoint a professor in the proposed faculty of commerce with a salary of £750.

REV. JAMES G. K. MCCLURE, D.D., for the last four years president of Lake Forest University, has handed his resignation to the board of trustees, and Rev. Richard D. Harlan, of Rochester, N. Y., has been elected to the presidency. Dr. McClure only intended to hold the presidency for a short period and had retained the pastorate of the Lake Forest Presbyterian Church.

AT Bryn Mawr College, Dr. Elinor P. Kohler has been promoted to be professor of chemistry and Dr. Allerton Seward Cushman has resigned the associateship in chemistry. Miss Harriet Brooks has been appointed resident fellow in physics and Miss Marie Reimer resident fellow in chemistry.

H. C. HASLAM, M.A., M.B., B.C., of Gonville and Caius College, has been elected to a John Lucas Walker studentship in pathology at Cambridge University. Dr. Sladen, who received permission to leave his work in Cambridge to join his mobilized militia battalion for service in Ashanti, and who has now returned, has been reinstated as a second student.

PROFESSOR ALFRED NEWTON, who holds the chair of zoology and comparative anatomy at Cambridge University, has been excused from delivering lectures during the coming year. His place will be in part supplied by Mr. W. Bateson.